REVA UNIVERSITY

Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B. TECH IN

ELECTRICAL AND ELECTRONICS ENGINEERING

2017-21

Rukmini Educational Charitable Trust

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.Tech (Electrical and Electronics Engineering) Program

HANDBOOK

2017-21

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Rukmini Educational Charitable Trust

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MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven engineering courses after studying the requirements of industries in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills to opt fordifferent job prospects across the global.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of B.Tech First year and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study.I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country.

I wish you every success in your career.

Dr. P. Shyama Raju
Chancellor, REVA University

MESSAGE FROM THE VICE CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the real world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care and after detailed market survey of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society. It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects. It facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the university. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing a brief information about ***B.Tech in Electrical ElectronicsEngineering***, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed and to work hard and make use of enormous resources and expert faculties to accomplish all round development of their personalities and succeed withflying colours not only in earning degree but also in their future career as leaders and proud citizens of mother India.

Dr. S.Y. Kulkarni
Vice-Chancellor

MESSAGE FROM THE DIRECTOR

The B.Tech in Electrical Engineering is designed keeping in view the current situation and possible future developments, both at national and global levels. This course is designed to give greater emphasis on core Electrical Engineering. There are ample number of courses providing knowledge in specialized areas of power system, electrical machines, control system, power electronics etc. facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts.

Electrical engineering is one of the earliest to start among the core subjects. The structure of the course has undergone a face-lift with the introduction of subjects from computer science and electronics engineering streams. Thus students in Electrical engineering have the flexibility to broaden their horizons in electronics or software related industries apart from the core related fields. For example, signal processing and communication theory related to mobile technology needs signal processing, robotics require control theory as well as programming skills and integrated circuits need VLSI techniques. Thus the electrical engineering stream is designed to provide you with several options to choose from for your later years. Electrical Engineering use mathematics, electronics, computing techniques and physics to solve real world problems. The Indian government plans to add another 100 GW of generation capacity during 2012-2017 and to pump 1.4 trillion to build national power transmission grid which will enhance inter-regional transmission capacity to 32 GW by 2013. Hence power sector offers lots of job opportunities for well qualified graduates.

The program is thus designed to expose students to various subjects having applications in power sectors, and IT and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. The curriculum caters to and has relevance to local, regional, national, global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

The curriculum caters to and has relevance to local, regional, national, global developmental needs.

Maximum number of courses are integrated with cross-cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

If you are interested in any one of the following, then EEE is the option you should consider.

- Power sector- to design robust power system, to implement measures to keep the system secure, to maintain quality of power, to mitigate harmonics, to damp oscillations, to design protective measures using relays and circuit breaker etc
- Renewable energy sources- to harness power from renewable sources using power

electronics devices, to study integration of these sources with the grid.

- Transport- electric vehicles, vehicle to grid power transactions
- High –Voltage engineering – study of breakdown mechanisms of insulators, search for new types of insulators, development of high voltage testing equipment.
- Power Electronics- design of compact and highly efficient power supplies, battery energy storage system, ultra-capacitor applications, aerospace power requirements, UPS, applications in power system using FACTS devices, interconnection of two regions via HVDC link.
- Computer – Developing algorithms to solve complex functions, developing simulation tools to simulate the entire system, applications to SMART grid.

The benefits of choosing Electrical and Electronics Engineering are:

- Flexibility to choose various fields upon graduation.
- Opportunity to work on live problems.
- Opportunity to work on environmental related technologies.
- Opportunity for programmers to develop software for electrical related projects.

I am sure the students choosing B Tech in Electrical and Electronics Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. Rajashekar P. Mandi
Director
School of Electrical and Electronics Engineering

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notch educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 45 acres of land equipped with state-of-the-art infrastructure and conductive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and other staff. Currently, REVA University offers 18 Post Graduate programs and 15 Graduate programs in Engineering, Architecture, Science and Technology, Commerce, Management Studies, Humanities and Legal Studies in addition to research degrees leading to PhD in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering, Science& Technology, Management Studies, Education, in the years to come.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis on knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced inall programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students’ placements.

ABOUT SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

The School of Electrical Engineering is supported by well qualified and dedicated faculty members. The school of Electrical and Electronics Engineering under REVA University is established in the year 2014 with an aim of developing human resources in the area of Electrical and Electronics Engineering. The School of EEE offers under graduate (UG) course in ‘Electrical and Electronics Engineering’ and post graduate (PG) course in ‘Advanced Power Electronics’ along with Doctoral program in various research areas of Electrical Engineering. It has experienced and qualified faculty in various areas such as Power systems, Power Electronics, VLSI, Signal processing, Embedded systems, Industrial drives, Energysystems and Control systems. The School is well equipped with laboratories catering to the development of experiments and projects in the aforementioned areas. The School has state of art computing facilities and latest softwares. Along with technical skills the School conducts various extracurricular and co- curricular activities to develop overall personality of the students.

The faculties have number of publications in reputed national and international journals/conferences. The school is also involved in funded research projects. The other important features of the school are individual counseling of students for academic performance, additional coaching classes for important subjects for all the semesters, soft skill development classes, scientific and student centered teaching- learning process.

Student’s welfare is given utmost priority here at School of Electrical Engineering. Advanced learning methods are adopted to make learning truly interactive. More focus is on discussion and practical applications rather than rote learning. Notes/handouts are given and critical thinking questions are asked to test understanding. Experienced, well qualified and friendly faculties always strive hard to provide best of education to students.

This is reflected in various core subjects offered within the program

Vision

“The School of Electrical & Electronics engineering aspires to develop excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards”

Mission

“To mould students to become skilled, ethical and responsible engineers for the betterment of society.”

Programme Educational Objectives (PEOs)

The programme helps to develop critical, analytical, innovative, creative and problem solving abilities amongst its graduates. The programme makes the graduates employable as electrical and electronic engineers in power and energy, manufacturing and service sectors. With further education and earning of higher level degrees help the graduates to pursue a career in academics or scientific organisations as researchers.

The Programme Educational Objectives are to prepare the students to:

1) Work as a member of a team for successful career and communicate effectively in multidisciplinary environment with highest ethics.
2) continue to learn in the areas of Electrical & Electronics Engineering and allied areas and implement effective strategies with the advancement of technologies in Electrical & Electronics Engineering
3) become an entrepreneur in the domain of Electrical & Electronics Engineering and other allied areas

Programme Outcomes (POs)

After undergoing this programme, a student will be able to:

1. An ability to understand the concept, identify, formulate, and solve complex electrical engineering problems by applying knowledge & principles of engineering, science, and mathematics
2. Identify, formulate, review research literature, analyze, interpret and draw conclusions from quantitative & qualitative data of an electrical and electronics system, component, or process to meet desired needs.
3. Design solutions for engineering problems and system components related electrical & electronic systems that meet economic, environmental, social, political, health and safety, and sustainability requirements.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in the field of electrical & electronics engineering.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex electrical and electronics circuits with an understanding of the limitations
6. Apply contextual knowledge to assess social, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and solve professional, legal and ethical issues pertaining to electrical & electronics engineering and its related fields
9. Function effectively as a team member or leader in diverse teams to accomplish a common goal in a multi-disciplinary teams

10. Communicate effectively on complex engineering activities with the engineering community and with society at large in both verbal and written forms.
11. Demonstrate knowledge and understanding of the engineering and managementprinciples to manage projects effectively in diverse environments as a member or leader of a team.
12. Engage in independent and life-long learning in the broader context of technological change for continued professional development.

Program Specific outcome:

1. Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits,analog and digital electronics circuits, control systems, electrical machines, power system, renewable energy system and electric vehicle.
2. Apply the appropriate, state of the art techniques and modern engineering hardware and software tools in electrical and electronics engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.
3. Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

Member of Board of Studies

Sl. No.	Name of Members	Designation
1	Dr. Rajashekar P Mandi Director & Professor, REVA University EEE Department rajashekarpm@reva.edu.in & Ph: 9448465065	Chairperson
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13	Mr. Mahesh G.S. Asst. Professor School of Electrical & Electronics Engg. REVA University, Bangalore	Member

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CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher- student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2017

1. **Teaching and Learning Process:**

   The teaching &Learning process under CBCS – CAGP of education in each course of study will have four components, namely**:**:

   (i) L= Lecture (ii) T= Tutorial (iii) P=Practice, (iv) D=Dissertation / Project; where:

   L stands for **Lecture** session consisting of classroom instruction.

   T stands for **Tutorial** session consisting participatory discussion / self study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

   P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

   D stands for Dissertation / Project to be carried out as a part of the course work.

2. **Courses of Study and Credits**

   a. The study of various subjects in B Tech degree program are grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

   b. In terms of credits, every **one hour session of L amounts to 1 credit per Semester.** In terms of credits, every **one hour session of L amounts to 1 credit per Semester** and a minimum of **two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P / D amounts to 2 credits** over a period of one Semester of 16 weeks for teaching- learning process.

   c. The total duration of a semester is 20 weeks inclusive of semester-end examination.

   d. **A course shall have either or all the four components.** That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

   e. The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P + D. **The credit pattern of the course is indicated as L: T: P:D.**

Different C**ourses of Study** are labeled and defined as follows:

a. Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i)Foundation Course, (ii) Hard Core Course, and (iii) Soft Core Course.

b. Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

c. Hard Core Course (HC):

The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any that the candidates have to complete compulsorily.

d. Soft Core Course (SC):

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/relatedbranch of study which supports the main branch of study.

e. O**pen Elective Course:**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an O**pen Elective Course.**

f. Project Work / Dissertation:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A project work carrying **FOUR or SIX** credits is called **Minor Project** work / **Dissertation.** A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called **Major Project** work / **Dissertation**. **A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.**

3. Scheme, Duration and Medium of Instructions:

1. B Tech degree program is of 8 semesters - 4 years duration. A candidate can avail amaximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete BTech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.
2. The medium of instruction shall be English

4. Minimum Credits to be Earned

4.1 **A candidate has to earn 192 credits for successful completion of B Tech degree** with the distribution of credits for different courses as prescribed by the university. A candidate can enroll for a maximum of 30 credits and a minimum of 20 credits per Semester. However he / she may not successfully earn a maximum of 30 credits per semester. This maximum of 30 credits doesnot include the credits of courses carried forward by a candidate.

4.2 **Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 192 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities**.

4.3. Add- on Proficiency Certification:

To acquire **Add on Proficiency Certification** a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 192 credits for the B Tech Degree program.

4.3.1. Add on Proficiency Diploma:

To acquire **Add on Proficiency Diploma,** a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 192 credits for the B Tech Degree program.

The A**dd on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 components as C1, C2, and C3.**

5.2. The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

a) Continuous assessment (C1 and C2) = 40 marks
b) Semester end (C3) examination = 60 marks

5.2.1 (i) Component C1:

The first Component (C1), of assessment is for 20 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for C2 immediately after completion of process of C1.

The finer split - up for the award of marks in C1 is as follows:

Assignment / Seminar..5 marks for Unit 1&2

Review Test (Mid-Term)..................................15 marks for Unit 1&2

Total...20 marks

5.2.2 (ii) Component C2:

The second component (C2), of assessment is for 20 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

The 17th week will be for revision of syllabus and preparation for the semester - end examination.

The finer split - up for the award of marks in C2 is as follows:

Assignment / Seminar....................................5 marks for Unit 3 & 4

Review Test (Mid-Term)..............................15 marks for Unit 3 & 4

Total..20 marks

5.2.3 The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) will be proposed by the teacher(s) concerned before the commencement of the semester and will be discussed and decided in the respective School Board. The students should be informed about the modalities well in advance. **The evaluated courses/assignments during Component I (C1) and Component II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concerned teacher for this purpose.**

5.2.4 (iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 60.**

Valuation will be undertaken concurrently and results are announced latest by the end of 20th week. This practice will be followed both in odd semester and even semester.

5.3. Evaluation of Practical Courses

5.3.1 A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

5.3.2. In case a course is fully of P type (L=0:T=0:P=4), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a. Continuous assessment (C1 and C2) = 40 marks
b. Semester end (C3) practical examination = 60 marks

The 40 marks meant for continuous assessment shall further be allocated as under:

i	Conduction of regular practical throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test	10 marks
	Total	**40 marks**

The 60 marks meant for Semester End (C3) Examination, shall be allocated as under:

i	Conduction of semester end practical examination	40 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**60 marks**

5.3.3 The C3 examination for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

In case a course is partly P type i.e., (L=3): (T=0) (P=1), then the examination for C3 component will be as decided by the BOS concerned.

5.3.4 The duration for semester-end practical examination shall be decided by the concerned School Board.

5.4. Evaluation of Minor Project / Major Project / Dissertation:

5.4.1. Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

6. Eligibility to Appear C3 (Semester - end) Examination

Only those students who fulfill a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the course(s), as provided in the succeeding sections, shall be eligible to appear for C3 examination.

7. Requirements to Pass the Semester and to Carry Forward the Failed Subjects / Courses:

7.1 Requirements to Pass a Course

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (20 + 20 + 60; i .e, C1 + C2 + C3) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (15 marks) in C3 which is compulsory.

7.2 Provision to Carry Forward the Failed Subjects / Courses:

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for C3 examination of failed courses of previous semesters concurrently with odd semester end examinations (C3) and / or even semester end examinations (C3) of current year of study.However, he / she shall have to clear all courses of both odd and even semesters of preceding yearto register for next succeeding semester.

Examples:-

a. Student "A" has failed in 1 Course in First Semester and 3 Courses in Second Semester. He / she is eligible to seek admission for Third Semester and appear for C3 examination of 1 failed Course of First Semester concurrently with Third Semester C3 examination. Likewise, he / she is eligible to appear for C3 examination of 3 failed Courses of Second Semester concurrently with Fourth Semester C3 examination. However, he / she has to clear all the failed Courses of First and Second Semesters before seeking admission to Fifth Semester.
b. Student "B" has failed in 2 Courses in Third Semester and 2 Courses in Fourth Semester and has passed in all Courses of First and Second Semesters. He / she is eligible to seek admission to Fifth Semester and appear for C3 examination of 2 failed Courses of Third Semester concurrentlywith Fifth Semester C3 examination. Likewise he / she is eligible to appear for C3 examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester C3 examination. However, he / she is not eligible to seek admission to Seventh Semester unless he / she passes in all the failed courses of Third and Fourth Semesters.
c. Student "C" has failed in 4 Courses in Fifth Semester but has cleared all the courses in Sixth Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for C3 examination of 4 failed Courses of Fifth Semester concurrently with Seventh Semester C3 examination. However, he / she has to pass all the failed courses of Fifth Semester along with Seventh and Eighth Semesters courses to earn B Tech Degree.
d. Student "D" passed in 1to 4 semesters, but failed in 3 courses of 5th Semester and in 1 course of 6th Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "D" is also eligible to seek admission for 7th Semester and appear for C3 examination of 3 failed courses of 5th Semester concurrently with 7th Semester C3 examination and one failed course of 6th Semester concurrently with 8th Semester C3 examination. However, he / she has to pass allthe 3 failed courses of Fifth Semester and 1 course Sixth Semester along with Seventh and Eighth Semester courses to earn B Tech Degree.

7.3 Re-Registration and Re-Admission:

a) In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination (C3) and he / she shall have to seek re- admission to that semester during subsequent semester / year within a stipulated period.

b) In case a candidate fails in more than 4 courses in odd and even semesters together in a given academic year (and is detained from moving to higher semester) he / she may opt to re-register either for the entire semester(s) or for such courses wherein, he / she has failed and repeat the semester(s) / courses. (However, such a candidate may also opt to re-appear during subsequent semester / year within a stipulated period, for C3 (semester end) examination to such of those courses that he /she has failed without re-registering).

c) In such a case where in a candidate drops all the courses in semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

8 Attendance Requirement:

8.1 All students must attend every lecture, tutorial and practical classes.

8.2 In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

8.3 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C3) examination and such student shall seek re-admission as provided in 7.8.4.

8.4 Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

8.5 Absence during Mid Semester Examination:

In case a student has been absent from a mid-semester (C1 and C2) examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester (C1 and C2) examination.

9 Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component.

b. The answer scripts for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

10 Grade Card and Grade Point

10.1 **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

10.2 **Final Grade Card:** Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

10.3 **The Grade and the Grade Point:** The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90>100	10	v*10	O
80>90	9	v*9	A+
70 > 80	8	v*8	A
60> 70	7	v*7	B+
55 > 60	6	v*6	B
50 > 55	5.5	V*5.5	C
40> 50	5	v*5	P
0-40	0	v*0	F
ABSENT			AB

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

10.3.1 Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e. : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA
Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A+**	**9**	**4X9=36**
Course 2	**4**	**A**	**8**	**4X8=32**
Course 3	**3**	**B+**	**7**	**3X7=21**
Course 4	**3**	**O**	**10**	**3X10=30**
Course 5	**3**	**P**	**5**	**3X5=15**
Course 6	**3**	**B**	**6**	**3X6=18**
Course 7	**2**	**O**	**10**	**2X10=20**
Course 8	**2**	**A**	**8**	**2X8=16**
	24			**188**

Thus, **SGPA = 188 ÷ 24 = 7.83**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**4**	**A**	**8**	**4X8=32**
Course 2	**4**	**B+**	**7**	**4X7=28**
Course 3	**3**	**A+**	**9**	**3X9=27**
Course 4	**3**	**B+**	**7**	**3X7=21**
Course 5	**3**	**B**	**6**	**3X6=18**
Course 6	**3**	**P**	**5**	**3X5=15**
Course 7	**2**	**B+**	**7**	**2X7=21**
Course 8	**2**	**O**	**10**	**2X10=20**
	24			**175**

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			199

Thus**, SGPA = 199 ÷ 24 = 8.29**

10.4 Cumulative Grade Point Average (CGPA):

10.4.1 Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : **CGPA = ∑(Ci x Si) / ∑Ci**

Where *Si* is the SGPA of the ith semester and *Ci* is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96
3	24	8.11	24 x 8.11 = 192.64
4	26	7.40	26 x 7.40 = 192.4
5	26	8.29	26 x 8.29 = 215.54
6	24	8.58	24 x 8.58 = 205.92
7	24	9.12	24 x 9.12 = 218.88
8	24	9.25	24 x 9.25 =222
Cumulative	196		1588.26

Thus, **CGPA** = $\frac{24x6.83+24x7.29+24x8.11+26x7.40+26x8.29+24x8.58+24x9.12+24x9.25}{196}$ = 8.10

10.4.2 CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10=81.0

10.5 Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Grade (Numerical Index) G	Letter Grade	Performance	FGP Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C	Average	
> 4 CGPA <5	5	P	Pass	Satisfactory

Overall percentage=10*CGPA

11 Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of thecourse concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

12. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

TRAINING AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self-motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

The REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling, Training and Placement (CCTP) Centre headed by well experienced dynamic Trainer, Counselor and Placement Officer supported by an efficient team does handle all aspects of Internships and Placement for the students of REVA University. The prime objective of the CCTP Centre is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CCTP Centre organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CCTP Centre forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Engineering is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the Training and Placement cell has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his/her interest and march forward to make better career.

Skill development is one of the very important activities of the University and Industry relationship.
A skill development centre is established to organize skill and certification programs. The students shall compulsorily complete at least two skill/certification based programs before the completion of the degree.

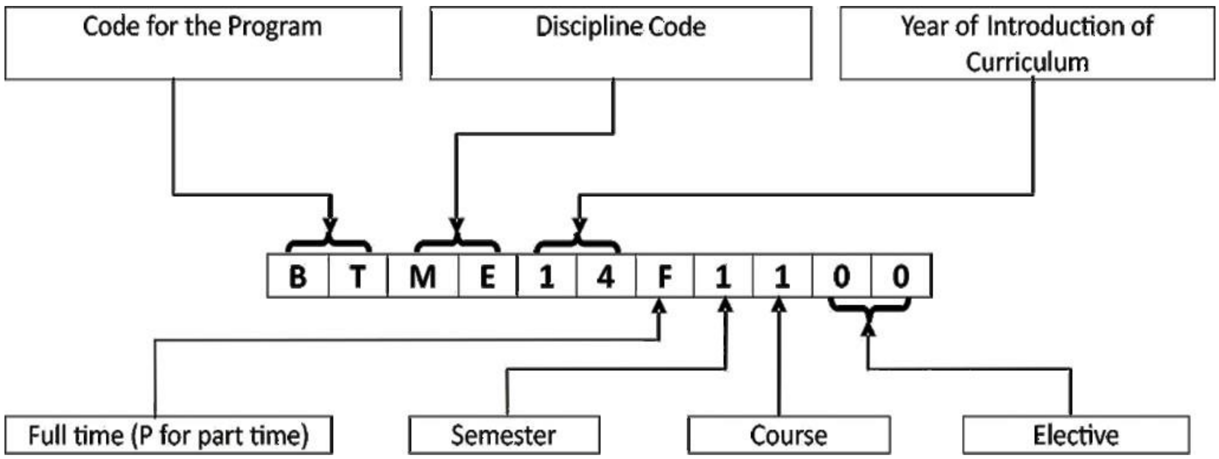
The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs.

The various skill/certification programs identified are as follows.

- Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX
- Red-hat certified programs on LINUX,
- Management related programs like SAP,ERP and Business Analytics
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration
- IBM certified programs.

The University has signed MOU's with Multi-National Companies, research institutions, Government agencies like NSDC (National Skill Development Corporation) and universities abroad to facilitategreater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business Management)	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering / Computer Science
MA	Master of Arts	DE	Data Engineering and Cloud Computing
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

Scheme of Instruction and Syllabus
B.Tech – Electrical & Electronics Engineering

I Semester Physics Cycle

SL	Course Code	Title of the Course	HC/SC/OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				C	L	T	P		
1	BTEM15F1100	Engineering Mathematics - I	HC	4	3	1	0	5	Mathematics
2	BTEP15F1200	Engineering Physics	HC	3	2	1	0	4	Physics
3	BTCV15F1300	Elements of Civil Engineering	HC	3	2	1	0	4	Civil
4	BTME15F1400	Elements of Mechanical Engineering	HC	3	2	1	0	4	MECH
5	BTEE15F1500	Basic Electrical Engineering	HC	3	2	1	0	4	EEE
6	BTIC15F1600	Indian Constitution and Professional Ethics	FC	2	1	1	0	3	Law
7	BTCE17F1700	Technical English I	FC	2	1	1	0	3	Humanities
8	BTPL15F1800	Physics Lab	HC	2	1	0	1	3	Physics
9	BTEC15F1900	Basic Electrical Engineering lab	HC	2	1	0	1	3	EEE
TOTAL CREDITS				**24**	**15**	**7**	**2**	**33**	

II Semester Chemistry Cycle

SL	Course Code	Title of the Course	HC/SC/OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				C	L	T	P		
1	BTEM15F2100	Engineering Mathematics – II	HC	4	3	1	0	5	Mathematics
2	BTEC15F2200	Engineering Chemistry	HC	3	2	1	0	4	Chemistry
3	BTBE15F2300	Basic Electronics Engineering	HC	3	2	1	0	4	ECE
4	BTCC15F2400	Computer Concepts & C Programming	HC	3	2	1	0	4	CSE
5	BTES15F2500	Environmental Sciences	FC	2	1	1	0	3	Civil
6	BTTC17F2600	Technical English II	FC	2	1	1	0	3	Humanities
7	BTED15F2700	Computer Aided Engineering Drawing	HC	4	2	0	2	6	MECH
8	BTCL15F2800	Engineering Chemistry Lab	HC	2	1	0	1	3	Chemistry
9	BTCP15F2900	Computer Concepts and C programming Lab	HC	2	1	0	1	3	CSE
TOTAL CREDITS				**25**	**15**	**6**	**4**	**35**	

III Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F3100	Engineering Mathematics–III	HC	4	3	1	0	5
2	BTEE15F3200	Electrical Circuit Theory- I	HC	3	2	1	0	4
3	BTEE15F3300	Electrical &Electronic Instrumentation and Measurements	HC	3	2	1	0	4
4	BTEE15F3400	Electrical Power Generation	HC	4	3	1	0	5
5	BTEE15F3500	Analog Electronic Circuit Design	HC	3	2	1	0	4
6	BTEE15F3600	Digital Electronic Circuit Design	HC	3	2	1	0	4
7	BTEE15F3700	Analog Electronic Circuit Design Laboratory	HC	2	1	0	1	3
8	BTEE15F3800	Digital Electronic Circuit Design Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**24**	**16**	**6**	**2**	**32**

IV Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F4100	Engineering Mathematics – IV	HC	4	3	1	0	5
2	BTEE15F4200	Electrical Circuit Theory- II	HC	3	2	1	0	4
3	BTEE15F4300	Electromagnetic Theory	HC	3	2	1	0	4
4	BTEE15F4400	Electrical Machines I	HC	3	2	1	0	4
5	BTEE15F4500	Microcontrollers and Applications	HC	3	2	1	0	4
6	BTEE15F4600	Power Electronics	HC	3	2	1	0	4
7	BTEE15F4700	Microcontroller Laboratory	HC	2	1	0	1	3
8	BTEE15F4800	Power Electronics Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**23**	**15**	**6**	**2**	**31**

V Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F5100	Control Engineering	HC	3	2	1	0	4
2	BTEE15F5200	Transmission and Distribution	HC	4	3	1	0	5
3	BTEE15F5300	Signals and Systems	HC	3	2	1	0	4
4	BTEE15F5400	Electrical Machines II	HC	3	2	1	0	4
5	BTEE15F5501	Electrical Power Utilization	SC	4	3	1	0	5
	BTEE15F5502	Electrical Drives						
	BTEE15F5503	Digital system design using VHDL						
	BTEE15F5504	Computer Networks Concepts and Protocols						
6	BTEE15F5601	Design of Electrical Machines	SC	4	3	1	0	5
	BTEE15F5602	Advanced Power Electronics						
	BTEE15F5603	Programmable Logic Controllers						
	BTEE15F5604	Programming in Java						
7	BTEE15F5700	Electrical Machines Laboratory I	HC	2	1	0	1	3
8	BTEE15F5800	Electrical and Electronics Measurements Lab.	HC	2	1	0	1	3
TOTAL CREDITS				**25**	**17**	**6**	**2**	**33**

VI Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F6100	Power System Analysis	HC	4	3	1	0	5
2	BTEE15F6200	High Voltage Engineering	HC	4	3	0	1	5
3	BTEE15F6300	Theory and Applications of Linear Integrated Circuits	HC	3	2	1	0	4
4	BTEE15F6401	Advanced Control Engineering	SC	3	2	1	0	4
	BTEE15F6402	Digital Relays						
	BTEE15F6403	Embedded systems and IOT						
	BTEE15F6404	Computer Organization and Architecture						
5	BTEE15F6501	Power System Planning and Reliability	SC	3	2	1	0	4
	BTEE15F6502	Modeling and Simulation of Electrical Machines						
	BTEE15F6503	Operation Research						
	BTEE15F6504	Web Programming						
6	BTEE15F6601	Smart grid	SC	4	3	1	0	5
	BTEE15F6602	Digital Signal Processing						
	BTEE15F6603	VLSI Circuits and Design						
	BTEE15F6604	Data Structures using C++						
7	BTEE15F6700	Electrical Machines Laboratory II	HC	2	1	0	1	3
8	BTEE15F6800	Control System Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**25**	**19**	**5**	**3**	**33**

VII Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F7100	Computer Aided Power System Analysis and Stability	HC	4	3	1	0	5
2	BTEE15F7200	CAED	HC	4	3	1	0	5
3	BTEE15F7300	Project Phase I	HC	2	0	1	1	4
4	BTEE15F7401	Power System Protection	SC	4	3	1	0	5
	BTEE15F7402	HVDC						
	BTEE15F7403	Industrial Instrumentation and Automation						
	BTEE15F7404	Operating system						
5	BTEE15F7501	Testing and Commissioning of Electrical Equipment	SC	4	3	1	0	5
	BTEE15F7502	Electricity Regulations						
	BTEE15F7503	Non Conventional Energy Sources						
	BTEE15F7504	Fuzzy logic system						
6	-	Open Elective subject offered by other school	OE	4	3	1	0	5
7	BTEE15F7700	Relay and High Voltage Laboratory	HC	2	1	0	1	3
8	BTEE15F7800	Power System Simulation Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**26**	**17**	**6**	**3**	**35**

VIII Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F8100	Project Phase II	HC	8	0	1	7	16
2	BTEE15F8201	Operation and Control of Power Systems	SC	4	3	1	0	5
	BTEE15F8202	Introduction to Flexible AC transmission system						
	BTEE15F8203	Estimation and Design of Electrical Installation						
	BTEE15F8204	Artificial Neural Network						
3	BTEE15F8301	Electrical Power Quality	SC	4	3	1	0	5
	BTEE15F8302	Electrical Distribution system						
	BTEE15F8303	Electrical Safety						
4	BTEE15F8401	Management & Entrepreneurship	SC	4	3	1	0	5
	BTEE15F8402	Electrical Energy Conservation						
	BTEE15F8403	Computer Control of Electric drives						
	BTEE15F8404	Trouble Shooting of Common Electrical Appliances						
TOTAL CREDITS				**20**	**9**	**4**	**7**	**31**

Credit Distribution

SL.No	Semester	Credits				
		HC	**FC**	**SC**	**OE**	**Total**
1	I	20	04	-	-	24
2	II	21	04	-	-	25
3	III	24	-	-	-	24
4	IV	23	-	-	-	23
5	V	17	-	8	-	25
6	VI	15	-	10	-	25
7	VII	14	-	8	04	26
8	VIII	08	-	12	-	20
Grand Total		**142**	**08**	**38**	**04**	**192**

Detailed Syllabus of B Tech in Electrical and Electronics Engineering

I Semester   Physics Cycle

<table>
<tr><td>Sub Code: BTEM15F1100</td><td rowspan="2">Engineering Mathematics – I</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Prerequisites:</td><td colspan="6">Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the concepts of differential calculus and its applications.
2. To familiarize with partial differentiation and its applications in various fields.
3. To familiarize with linear algebraic applications and different reduction techniques.
4. To familiarize with concept of vector calculus and its applications.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course the student will be able to:
1. Apply the knowledge of differential calculus in the field of wave theory and communication systems.
2. Apply the knowledge of Differential Equations in the field of Engineering.
3. Analyze and implement the concepts of Divergence and curl of vectors which play significant roles in finding the Area and volume of the closed surfaces.
4. Apply the knowledge of convergence of the series, which help in forming JPEG image compression.
5. To determine whether a sequence or a series is convergent or divergent and evaluate the
limit of a convergent sequence or the sum of a convergent series.</td></tr>
</table>

Course Contents

UNIT-I Differential Calculus-I **[14 hr]**

Successive differentiation-nth derivatives (proof and problems), Leibnitz Theorem (without proof) and problems, Taylors series and Maclaurins series expansion for one variable (only problems), Polar curves- Angle between the radius vector and tangent, angle between two curves, Pedal equation for polar curves.

UNIT-II Differential Calculus-II **[14 hr]**

Derivative of arc length – concept and formulae without proof, Radius of curvature-Cartesian, parametric, polar and pedal forms (without proof) problems.

Indeterminate forms and solution using L'Hospital's rule.

Partial Differentiation: Partial derivatives-Euler's theorem-problems, Total derivative and chain rule,

UNIT-III Differential Calculus-III and Differential equations **[14 hr]**

Jacobians-definition and problems (only find $J$and*reference- one example on $JJ^{/}$=1). Taylor's Expansion of function of two variables (only problems- up to 2^{nd} order).

Maxima and Minima for a function of two variables (simple problems).

Differential equations: Exact equation and reducible to exact form (1. Close to expression M or N and find IF, 2. y f(x) dx+x g(y) dy)

UNIT-IV Integral Calculus **[14 hr]**

Reduction formulae for the integrals of $\sin^n x$,$\cos^n x$,$\sin^m x\cos^n x$ and evaluation of these integrals with standard limits(direct result) - Problems.

Multiple Integrals – Double integrals, change of order of integration (simple problems), and triple integrals. Beta and Gamma functions (definition),(properties and duplication formula - without proof), Relation between beta and gamma function and simple problems.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

<table>
<tr><td>Sub Code: BTEP15F1200</td><td rowspan="2">Engineering Physics</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Prerequisites:</td><td colspan="6">Basic knowledge of physics of pre-university</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide the students the fundamentals of Physics and make their basic foundation in engineering education very strong.
2. To expose the students of different branches of engineering with a theoretical and practical knowledge of Engineering Physics
3. To prepare students and make them ready to take up higher semester core engineering subjects by giving them strong physics background.
4. Students should be getting knowledge of different physical systems, basic quantum mechanics and materials science etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the student will be able to:
1. Apply knowledge of physics to different systems and analyze different problems.
2. Understand the need of quantum mechanics and its importance and applications
3. Get the knowledge to explain electrical conductivity of materials.
4. Get exposed to recent trends in nanoscience and technology.
5. Understand and demonstrate different applications of lasers, optical fibers, superconductors etc.</td></tr>
</table>

Course Contents

UNIT-I Wave mechanics: **[14 hr]**

Introduction to Wave mechanics, Wave particle dualism. de-Broglie hypothesis, Matter waves and their characteristic properties. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity. Relation between group velocity and particle velocity, Expression for de-Broglie wavelength using the concept of group velocity. Heisenberg's uncertainty principle, its significance and its applications (nonexistence of electron inside the nucleus). Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well. Numerical.

UNIT-II Lasers and optical fibers: **[14 hr]**

Lasers Interaction between radiation and matter (induced absorption, spontaneous and stimulated emission). Expression for energy density at thermal equilibrium in terms of Einstein'scoefficients. Characteristics of laser light, Conditions for laser operation (population inversion and Meta stable state). Requisites of laser system, Construction and working of Carbon Dioxide (CO_2) laser & semiconductor laser. Applications: Holography (recording and reconstruction of images) and its applications, Numerical.

Optical fibers: Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Condition for wave propagation in optical fiber, V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram, Optical source (LED) and detector (Photodiode). Advantages and limitations of optical communications, Numerical.

UNIT-III Electrical properties of conductors and superconductors: [14 hr]

Electrical Conductivity in Metals, Drude-Lorentz classical free electron theory, drift velocity, mean free path, mean collision time and relaxation time. Expression for electrical conductivity in metals, Effect of impurity and temperature on electrical resistivity in metals, Failures of classical free electron theory. Quantum free electron theory, Fermi-Dirac statistics, Fermi level, Fermi energy and Fermi factor, Variation of Fermi factor with energy and temperature, Density of states (qualitative explanation), effective mass, Merits of Quantum free electron theory, Numerical.

Superconductors: Temperature dependence of resistivity in superconductors, variation of critical field with temperature, Properties of superconductors (Isotope effect, Meissner effect, Silsbee effect), Types of superconductors, BCS theory, Applications of super conductors, Maglev vehicle and superconducting magnet.

UNIT-IV Ultrasonics, Dielectric and Nanomaterials: **[14 hr]**

Ultrasonics: Production of ultrasonics by piezoelectric method, Measurement of velocity of ultrasonics in solid and liquid, Non-destructive testing of materials using ultrasonics.

Dielectric materials: Electric dipole and dipole moment, electric polarization (P), dielectric susceptibility (χ,), dielectric constant, relation between χ and P, Electrical polarization mechanisms (electronic, ionic, orientational, space charge polarization), Expression for internal field in one- dimensional solid dielectrics, Ferro, Piezo and Pyro electric materials – theirproperties and applications, Numericals.

Nanomaterials: Introduction to nanoscience, nanomaterials and their applications, Synthesis of nano materials using bottom-up method (arc method), top-down methods (ball milling method), Carbon Nanotubes: properties and applications.

Text books:

1. Engineering Physics, R.K Gaur and S.L. Gupta, Dhanpat Rai Publications(P) Ltd, New Delhi.
2. A text book of Engineering Physics, M.N. Avadhanulu and P.G. Kshirsagar, S. Chand and Company, New Delhi.
3. Solid State Physics, S.O. Pillai, New Age International publishers, New Delhi.

Reference Books:

1. Laser Fundamentals, William T. Silfvast, 2nd Edition, Cambridge University press, New York (2004).
2. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York (2001).
3. Introduction to Solid State Physics,7th Edition Charls Kittel, Wiley, Delhi (2007).
4. Arthur Beiser, Concepts of modern Physics, Tata McGraw Hill publications, New Delhi.

Sub Code: BTCV15F1300	**Elements of Civil Engineering**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		3	2	1	0	4
Course Objectives	1. To enable students to establish a broad concept of engineering mechanics. 2. To enable students to understand the basics of composition of coplanar forces. 3. To enable students to understand the concept of equilibrium of coplanar forces. 4. To provide an overview of centroid of plane area & Moment of Inertia of plane area.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the moment of force and couples and equivalent force-couple system. 2. Solve numerical problems on composition of coplanar concurrent and non-concurrent force system. 3. Solve numerical problems on equilibrium of coplanar force system. 4. Locate the centroid and moment of inertia of different geometry.					

Course Contents

UNIT-I: Engineering mechanics **[14 hr]**

Introduction to basic civil engineering – Scope of civil engineering, role of civil engineer, branches of civil engineering (brief discussion 2 to 3 hours only)

Engineering mechanics

Basic idealizations - Particle, Continuum and Rigid body; Force and its characteristics, types of forces, Classification of force systems; Principle of physical independence of forces, Principle of superposition of forces, Principle of transmissibility of forces; Newton's laws of motion, Introduction to SI units, Moment of a force, couple, moment of a couple, characteristics of couple, Equivalent force - couple system, Resolution of forces, composition of forces; Numericalproblems on moment of forces and couples and equivalent force - couple system.

UNIT-II Analysis of Force Systems **[14 hr]**

Composition of forces - Definition of Resultant, Composition of coplanar -concurrent force system, Parallelogram Law of forces, Principle of resolved parts, Numerical problems on composition of coplanar concurrent force systems, Composition of coplanar - non-concurrent force system, Varignon's principle of moments; Numerical problems on composition of coplanar concurrent force systems.

UNIT-III Equilibrium of coplanar forces **[14 hr]**

Definition of static equilibrium and Equilibrant, Conditions of static equilibrium for different coplanar force systems, Lami's theorem, Concept of Free Body Diagram, Numerical problems on equilibrium of coplanar – concurrent and non-concurrent force systems.

UNIT-IV Centroid and Moment of Inertia **[14 hr]**

Centroid: Introduction to the concept, Centroid of plane figures, Locating the centroid oftriangle, semicircle, quadrant of a circle and sector of a circle using method of integration, Centroid of composite sections; Numerical problems.

Moment of Inertia: Introduction to the concept, Rectangular and polar moment of inertia, Radius of gyration, Perpendicular axis theorem and Parallel axis theorem, Moment of Inertia of rectangle, circle, semi-circle, quarter circle and triangle from method of integration, Moment of inertia of composite areas, Numerical problems.

Text Books:

1. M. N. Shesha Prakash and Ganesh B. Mogaveer, **“Elements of Civil Engineering and Engineering Mechanics”**, PHI Learning, 3rd Revised edition
2. A. Nelson, **“Engineering Mechanics-Statics and Dynamics”**, Tata McGrawHill Education Private Ltd, New Delhi, 2009
3. S. S. Bhavikatti, **“Elements of Civil Engineering”**, New Age International Publisher, New Delhi, 3rd edition 2009.

Reference Books:

1. S. Timoshenko, D.H. Young and J.V. Rao, **“Engineering Mechanics”**, TATA McGraw-Hill Book Company, New Delhi
2. Beer FP and Johnston ER, **“Mechanics for Engineers- Dynamics and Statics”**, 3rd SI Metric edition, Tata McGraw Hill. - 2008
3. Shames IH, **“Engineering Mechanics–Statics & Dynamics”**, PHI–2009.

<table>
<tr><td>Sub Code: BTME15F1400</td><td rowspan="2">Elements of Mechanical Engineering</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To develop the basic knowledge of working of various turbines and IC engines
2. To incorporate the concepts of metal joining process, their applications and power transmission modes like belt drives, gears and gear trains
3. To understand various mechanical machines and operations.
4. Introduce about lubrication and its importance.
5. To understand basic power transmission concepts.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">The student will be able to
1. Apply the concepts of working principle of turbines in the power plants and also of the IC engines in the basic design of the vehicles
2. Have a basic knowledge of metal joining and power transmission and apply them in some basic requirements
3. Gain the knowledge about machine tools and cutting operations.
4. Gain the knowledge about belt and gear drive power transmission.</td></tr>
</table>

Course Contents

UNIT–I **[14 hr]**

Properties of steam - Introduction**,** Steam formation, Types of steam. Steam properties, Specific Volume, Enthalpy and Internal energy, Steam table and simple numerical problems

Steam Generators – classification, Lancashire boiler, Babcock and Wilcox boiler, Boiler mountings, accessories and applications

Turbines- Introduction to turbines & prime movers, Classification of turbines, Working principle and applications of impulse and reaction steam turbines, gas turbines (open and closed cycle type) and water turbines (Peloton wheel, Francis and Kaplan), Compounding of impulse turbine

UNIT–II **[14 hr]**

Internal Combustion Engines – Introduction, Classification of IC engines, parts of IC engine, Working principle of four stroke (petrol and diesel) and two stroke petrol engines, differences between 4 Stroke & 2 Stroke engines and petrol & diesel engines, Numerical problems on power and efficiencies.

Refrigeration and Air conditioning- Introduction, Principle of refrigeration, parts ofrefrigerator, Principle and working of vapor compression refrigeration and vapor absorption refrigeration. Refrigerants, Properties of refrigerants, Refrigerating effect, Ton of Refrigeration, COP, Relative COP, UNIT of Refrigeration, Principle and applications of Room air conditioners.

UNIT–III **[14 hr]**

Machine Tools- Introduction, working principle and classification of lathe, drilling and milling machines, major parts of a lathe and their functions, lathe operations on lathe - Specifications of lathe, parts of radial drilling machines, drilling operations, parts of horizontal milling machines, milling operations.

Metal joining processes- Introduction, classification of metal joining processes, method of welding (Electric Arc welding), soldering and brazing and their differences.

UNIT-IV **[14 hr]**

Lubrication- Necessity, types of lubrications, properties of good lubricant.

Bearings- Classification and application of bearings only.

Power Transmission- Introduction to transmission systems and its classification, types of Belt Drives**,** Definitions of Velocity ratio, angle of contact Creep and slip, Idler pulley, stepped pulley, fast & loose pulley, simple problems.

Gears - Definitions, Spur gear terminology, Types and applications of Gears.

Gear Trains – Simple and compound gear trains, Simple problems on gear trains.

Text Books:

1. A Text Book of Elements of Mechanical Engineering – K.R. Gopalkrishna, Subhash Publishers, Bangalore.
2. Elements of Mechanical Engineering – Kestoor Praveen and M.R. Ramesh 2nd Edition 2011, Suggi Publications

Reference Books:

1. The Elements of Workshop Technology - Vol. I & II , SKH Chowdhary, AKH Chowdhary , Nirjhar Roy, 11th edition 2001, Media Promotors and Publishers, Mumbai.

Sub Code: BTEE15F1500	**Basic Electrical Engineering**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		3	2	1	0	4
Course Objectives	1. To establish a broad concept of various types of generation of electricity. 2. To make students understand the basics of representation of electrical quantities and relationship among them. 3. To provide an overview of various types of electrical apparatus. 4. To introduce the concept of domestic wiring and importance of safety and sensing devices. 5. To provide an insight into various sources of power generation.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the operation and control of various types of generation of electricity 2. Describe the principle of operation of electrical apparatus 3. Differentiate between single and three phase systems 4. Solve simple mathematical relationships related to electrical apparatus. 5. Relate the applications of electronic devices and sensors in practical life.					

Course Contents

UNIT-I Introduction to Electrical Parameters **[14 hr]**

Concept of Alternating Voltage and Current, Sinusoidal functions-specifications, Phasor representation, concept of impedance, admittance, conductance and susceptance –series and parallel circuits of RLC. Concept of power and power factor. Kirchoff's laws and network solutions. Electromagnetic induction-laws, direction & magnitude of induced emf, mmf, permeability, reluctance and comparison of electric and magnetic circuits. Self and mutual inductance of a coil, coupling coefficients. Concept of energy storage in L & C, resonance between L &C. Generation of three phase voltages, star-Wye configurations, relation between line and phase quantities and expression for power.

UNIT-II Electrical Apparatus **[14 hr]**

DC generator, DC motor- concept of force, torque and mechanical work. Single and three phase induction motors, shaded pole motor, universal motor, stepper motor: Basic construction, principle of operation and applications. Single and three-phase transformers: Principle, emfequation.

UNIT-III Generation & Distribution: **[14 hr]**

Block diagram representation of generation, transmission and distribution. Current generation and transmission scenario, need for transmission at high voltage. Block diagram representation of thermal, hydel, nuclear, diesel and renewable power plants. Concept of smart-grid and role of ICT in smart-grid.

UNIT-IV Tariff, Protective Devices and Sensors **[14 hr]**

Tariff schemes, basic concepts of domestic wiring and types, earthing, protective fuses, MCB. Sensors: pressure sensor, strain gage, proximity sensor, displacement sensor, rotary encoder and ultrasonic sensors (applications in relevant disciplines- ref to 8 and 9)

References:

1. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education, 5th Edition, 2007
2. Hughes, "Electrical Technology", International Students 9th Edition, Pearson, 2005
3. Kulshreshtha C, "Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition, 2011

4. Mittle V.N. and A. Mittal, "Basic Electrical Engineering" Tata McGraw Hill, 2nd Edition, 2005
5. Kothari D.P., L.J. Nagrath "Basic Electrical Engineering", Tata McGraw Hill, 2009
6. Robert L. Boylestad and Louis Nashelsky, "Introduction to Electricity, Electronics and Electromagnetics" Prentice Hall, 5th edition, 2001
7. Introduction to smart grid: http://www.occ.ohio.gov/publications/electric/Smart_Grid_An_Introduction.pdf
8. Role of ICT in smart grid: http://users.atlantis.ugent.be/cdvelder/papers/2010/develder2010sgc.pdf
9. Sensors: http://www.omron-ap.co.in/technical_guide/
10. Strain gage with bridge circuit: http://www.facstaff.bucknell.edu/mastascu/elessonshtml/Sensors/StrainGage.htm#SensorsInVoltageDividerCircuits

Sub Code: BTIC15F1600	**Indian Constitution and Professional Ethics**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		2	1	1	0	3
Prerequisites	Pre-university level Constitution of India and Professional Ethics					
Course Objectives	1. To provide and gain knowledge on Constitution of India. 2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law. 3. To prepare students in the practicality of Constitution perspective and make them face the world as a bonafide citizen. 4. To attain knowledge about ethics and also know about professional ethics. 5. Explore ethical standards followed by different companies.					
Course Outcomes	On completion of this course the student will be able to: 1. Strengthen the knowledge on Indian constitutional law and make the practical implementation of it. 2. Understand the fundamental rights and human rights. 3. Get the knowledge to explain the duties and more importantly practise it in a right way. 4. Adopt the habit of raising their voice against a non constitutionality of any laws and upon any legal discrimination as we have session of debates on Constitutional validity. 5. Get exposed about professional ethics and know about etiquettes about it. 6. Know about ethical standards of different companies which will increase their professional ability.					

Course Contents

UNIT-I Constitution of India [8 hr]

Definition, Making of Indian Constitution, Preamble to the Constitution of India, Fundamental Rights under Part III; Rights to Equality, Right to Freedom, Right against Exploitation, Rights to Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Fundamental Duties of the Citizen, Significance and Characteristics. Elements of National Significance; National Flag, National Anthem, National Emblem.

UNIT-II Union and State: [8 hr]

Organs of the Government; Legislature, Executive and Judiciary. Union and State Executives: President, Vice President, Prime Minister, Supreme Court, Cabinet, Governor, Council of Ministers, Electoral process, Election Commission. Right to Information (RTI), Consumer and Consumer Protection.

UNIT III Ethics: [8 hr]

Meaning, Definition, Evolution, Need of ethics,Aristotlean Ethics, Utilitarianism, Katianism, Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT IV Engineering Ethics: [8 hr]

Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companiesin India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence.

Reference books:

1. M V Pylee, An introduction to Constitution of India.
2. M Govindarajan, S Natarajan, V S Senthil Kumar, Engineering.

Sub Code: BTCE17F1700	**Technical English I**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		2	1	1	0	3
Course Objectives	1. To enable learners of Engineering and Technology develop their basic communication skills in English.					

	2. To emphasize specially the development of listening and reading skills among learners of Engineering and Technology. 3. To equip them with writing skills needed for academic as well as workplace context. 4. To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
Course Outcomes	On completion of the course, learners will be able to: 1. Listen/view and comprehend different spoken discourses/excerpts in different accents. 2. Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies. 3. Read different genres of texts adopting various reading strategies. 4. Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

Course Outline:
This is a 2 credit course for first semester consisting of 4 hours of teaching learning per week, inclusive of direct classroom teaching and practice in language lab.

Course Contents

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	Communicative Skills & Functional English	**25 Marks** Fill in the blanks/ MCQs/ Short Notes/ Descriptive Answers	1. Basics of Communication 2. Verbal & Non-verbal Communication 3. Barriers to Effective Communication 4. Strategies of Effective Communication 5. Tenses 6. Conditional Sentences 7. Auxiliaries (Modal & Primary)	16 Hours
II	Listening & Reading Skills	**25 Marks** Short Notes/ Descriptive Answers/ Comprehension Tasks	1. Definitions (Listening & Reading) 2. Types of Listening 3. Barriers to Effective Listening 4. Traits of a Good Listener 5. Types of Reading 6. Techniques of Effective Reading 7. Reading Tasks (Critical & Inferential)	16 Hours

III	Academic Writing – I	**25 Marks** Short Notes/ Descriptive Answers	1. Paragraphs 2. Notice/ Agenda/ Minutes 3. Note Taking/ Note Making 4. Summarizing 5. Project Reports	16 Hours
IV	ICT/ Digital/ E-Skills	**25 Marks** Short Notes/ Descriptive Answers	1. Computer Assisted Language Learning (CALL) 2. Mobile Assisted Language Learning (MALL) 3. Emails 4. Blogs 5. Digital/ E-Portfolio 6. Filling Online Application Forms	16 Hours

References:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

Sub Code: BTPL15F1800	**Engineering Physics Lab**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		2	1	1	0	3
Course Objectives	1. To make the students gain practical knowledge of Physics to co- relate with the theoretical studies. 2. To provide students with a theoretical and practical knowledge of Physics. 3. To achieve perfectness in experimental Skills and the study of practical applications improve confidence and ability to develop and fabricate engineering and technical equipments. 4. Students should be getting idea of basic electronic circuits, optical instruments and will be able to carry out experiments in optics and verify other important laws of Physics.					
Course Outcomes	At the end of the course a students are able to 1. Develop skills to apply practical knowledge of Physics in real time solution. 2. To understand and verify different laws of Physics using some simple experiments.					

	3. To design simple electrical circuits and analyze obtained result. 4. Ability to apply knowledge of basic electronics in making simple circuits using diodes and transistors and analyze the responses. 5. Ability to use the knowledge acquired for different applications and projects.

List of Experiments:

1. Determination of wavelength of the given laser using diffraction grating.
2. I-V characteristics of Zener-diode – (determination of knee voltage breakdown voltage and forward resistance).
3. Determination of Planck's constant using LED.
4. Determination of energy gap of a semiconductor.
5. Measurement of dielectric constant by charging and discharging method.
6. Determination of Fermi energy of copper.
7. I-V characteristics of NPN-Transistor in C-E mode. (Determination of knee voltage input resistance, output resistance, current gain and current amplification factor breakdown).
8. Photo diode characteristics (I-V characteristics in reverse bias, variation of photocurrent as a function of intensity and reverse voltage).
9. Determination of Young's modulus of the material by single cantilever method/uniform bending method.
10. Determination of resonant frequency, band width and quality factor of the given LCR series and parallel resonance circuits.
11. Determination of rigidity modulus of the material and moment of inertia of an irregular body using Torsional pendulum.
12. Measurement of numerical aperture and attenuation in optical fibers. (Demo Expt.)
13. Determination of electrical resistivity by four probe method. (Demo expt.)
14. Measurement of velocity of ultrasonic's in the given liquid-acoustic grating method. (Demo Expt.)

Sub Code: BTEC15F1900	**Basic Electrical Engineering Lab**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		2	1	1	0	3
Course Objectives	1. To establish a broad concept of various types of electrical apparatus, tools and instrumentation. 2. To provide hands on experience with electrical apparatus and electrical safety norms. 3. To train students to read and understand schematics so as to make					

	electrical connection for different appliances. 4. To train students in collecting and interpreting experimental data. 5. To enhance written skills of students.
Course Outcomes	On completion of this course the students will be able to: 1. Use appropriate electrical tools for electrical connections and repair of electrical equipments. 2. Recognize various symbols in a schematic and make connection as per the schematic 3. Systematically follow various safety procedures. 4. Make use of various measuring instruments to collect experimental data 5. Relate experimental results with theoretical analysis. 6. Demonstrate the ability to critically evaluate the performance of an electrical appliances.

List of experiments

1. Electrical tool introduction

(i) Electrical Tools

(ii)Measuring Instruments like Ammeter, Voltmeter, Multimeter, Clamp on meter, Energy meter, Watt meter (UPF & LPF)

2. Home electrical wiring demonstration:

(i) Tube light wiring

(ii) Fan wiring

(iii) Two way control

(iv) Socket to switch connection.

(v) Electrical wiring materials & accessories

3. Study of mutual induction effect.

4. Electrical safety training:

(i) Electrical activities to avoid shocks and importance of earthing

(ii)Working of MCB, ELCB

(iii) Role of fuse.

5. Home electrical wiring demonstration: short circuit, series and parallel operation of load.

6. Single phase transformer: polarity tests.

7. Diode rectifier applications: Half wave and Full wave rectifier, ripple factor calculations.

8. Sensor experiments: Pressure sensor, light sensor and temperature sensor.

9. DC Machine demonstration.

II Semester   Chemistry Cycle

SL	Course Code	Title of the Course	HC/SC/OE	Credit Pattern & Credit Value				CH	Teaching School/Dept.
				C	L	T	P		
1	BTEM15F2100	Engineering Mathematics – II	HC	4	3	1	0	5	Mathematics
2	BTEC15F2200	Engineering Chemistry	HC	3	2	1	0	4	Chemistry
3	BTBE15F2300	Basic Electronics Engineering	HC	3	2	1	0	4	ECE
4	BTCC15F2400	Computer Concepts & C Programming	HC	3	2	1	0	4	CSE
5	BTES15F2500	Environmental Sciences	FC	2	1	1	0	3	Civil
6	BTTC17F2600	Technical English II	FC	2	1	1	0	3	Humanities
7	BTED15F2700	Computer Aided Engineering Drawing	HC	4	2	0	2	6	MECH
8	BTCL15F2800	Chemistry Lab	HC	2	1	0	1	3	Chemistry
9	BTCP15F2900	Computer programming Lab	HC	2	1	0	1	3	CSE
TOTAL CREDITS				**25**	**15**	**6**	**4**	**35**	

Sub Code: BTEM15F2100	**Engineering Mathematics – II**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		4	3	1	0	5
Prerequisites	Knowledge of basics of derivatives, vectors, complex numbers					
Course Objectives	1. To understand the concepts of Linear algebra and its applications in various fields of engineering and Technology. 2. To understand the concepts of Integral calculus and its applications. 3. To familiarize with partial differential equations, and its applications to standard problems like Heat, Wave and Laplace. 4. To impart the Knowledge of Laplace transforms and its applications in the field of engineering.					
Course Outcomes	After the completion of the course the student will be able to: 1. Apply the knowledge of Linear Algebra in Image processing and digital signal processing. 2. Apply the knowledge of Integral calculus to perform integration and other operations for certain types of functions and carry out the computation fluently. 3. Apply the knowledge of partial differential equations in the field of signals and systems, control systems, magnetic wave theory. 4. Apply the knowledge of Laplace transformation from the time domain to the frequency domain, which transforms differential equations into algebraic equations and convolution into multiplication.					

Course Contents

UNIT-I Linear Algebra **[14 hr]**

Rank of matrix, Echelon form, (*reference-Normal form: one example), Solution of a system of linear equations by Gauss elimination (*reference-Gauss –Jordan methods: one example), Gauss seidel iterative method, Rayleigh Power method to find the largest eigen value and corresponding eigen vector.LU decomposition, Linear and Inverse transformation.

Diagosnalisation of a matrix, Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT-II Differential Equations: **[14 hr]**

Linear Differential Equations: Definitions, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral.

Method of variation of parameters (simple problems), Cauchy's and Legendre's linear differential equations.

Partial differential equation: Formation of Partial differential equations, Solution of Lagranges linear PDE.

UNIT-III Vector Calculus **[14 hr]**

Curves in space, tangents and normal, Velocity and acceleration related problems, scalar and vector point functions-Gradient, Divergence and curl, directional derivatives. Solenoidal and irrotational vector fields. Vector identities-div($\emptyset A$), curl($\emptyset A$), curl(grad$\emptyset$), div(curl A).

Line integral-Circulation-work, Surface integral: Green's Theorem, Stokes Theorem.

Volume integral: Divergence theorem. (All theorems without proof, no verification, only evaluation).

UNIT-IV Laplace Transforms: **[14 hr]**

Definition, Transforms of elementary functions, properties of Laplace Transforms (without proof) problems. Transforms of periodic functions (only statement and problems), Unit step functions and unit impulse functions.

Inverse Laplace transforms- Problems, convolution theorem (without proof) - verification and problems, solution of linear differential equation using Laplace transforms.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.

2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th Edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

<table>
<tr><td>Sub Code: BTEM15F2100</td><td rowspan="2">Engineering Chemistry</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand basic principles of Cell and Batteries, types of electrodes and their importance in some applications
2. To study and understand the materials required for designing and proper functioning of batteries.
3. To understand the Corrosion and metal finishing that explains why and how materials corrode and their prevention.
4. To understand the properties of various polymeric materials and their commercial significance.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course the student will be able to:
1. Know the importance of electrodes and materials in designing abattery
2. Apply the knowledge of Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion
3. Fabricate of PCB which is an important component for electronic industries
4. Apply the knowledge of Properties of polymers and their applications in various field, also that of composite materials insports, aviation etc.,</td></tr>
</table>

Course Contents

UNIT-I Cells and Batteries: **[14 hr]**

Introduction to electrochemistry, Basic concepts, Battery characteristics –primary, secondary and reserve batteries, Super capacitors, Lithium batteries.

Fuel cells-Difference between battery and fuel cell, types of fuel cells- construction working, applications, advantages& limitations of Solid oxide fuel cells and phosphoric acid fuel cell.

Photovoltaic cell-Production of single crystal semiconductor by Crystal pulling technique (Czocharlski method), zone refining of si, antireflective coatings, Construction and working of photovoltaic cells and its applications and advantages using elemental si and semiconductors.

UNIT-II Corrosion & its control & metal finishing. [14 hr]

Introduction: Electrochemical theory of corrosion, Galvanic series Types of Corrosion-Differential metal corrosion Differential aeration corrosion(Pitting & water line),Stress corrosion (Caustic embrittlement), and Grain boundary corrosion, Factors affecting rate of corrosion-Primary, secondary, pilling bed worth role, Energy concept (Pourbiax) under different pH conditions. Corrosion Studies on Al, Fe with phase diagram Corrosion control: Inorganic coating -Anodizing & Phosphating, metal coating- galivanzing & tinning, cathodic protection, Anodic Protection. Role of secondary reference electrode in corrosion studies (calomel ,Ag/AgCl)

Metal Finishing-Technological importance, significances of polarization. Decomposition potential & overvoltage in electroplating, theory of electroplating. Effect of plating variables on the nature of electrodeposit- electroplating process, Electroplating of gold, Introduction to Electro less plating-Cu.

UNIT-III Introduction to Nano science and Nanotechnology [14 hr]

Introduction to Nanomaterials, Properties –optical, electrical, magnetic and thermal .Chemical synthesis of Nanomaterials – sol gel (MOx NPs), phase transfer method (Au NPs). Carbon Nanomaterials-Fullerenes, graphene, CNT. Applications of nano materials- nano catalysis, nano-electronics, energy conversion materials (in batteries, solar cells), nano sensors.

Introduction to electromagnetic spectrum-material analysis, Instrumentation-principle, working and applications of UV-Visible, XRD, SEM.

UNIT-IV Polymers: [14 hr]

Introduction, Types of polymerization-Addition and Condensation, Ziegler's Natta catalyst, molecular weight determination by viscosity method, glass transition temperature, Structure and Property relationship. Synthesis & Applications of -Bakelite, ABS, Nylon, PMMA. Adhesives-Synthesis and applications of epoxy resins, Polymer composites- Synthesis and applications of Kevlar and Carbon fibers, Conducting polymers-Definition, Mechanism of conduction in polyacetylene, Synthesis & applications of conducting Polyaniline, Polymer liquid crystals, Biopolymers, Polymer membranes-ion exchange & ionic conductivity

REFERENCES:

1. Engineering chemistry by R.V. Gadag and Nithyananda shetty, Ik Interanational Pudlishing House
2. Engineering chemistry by R.Venugopal, Pushpa Iyengar, B.S. Jayaprakash and Shivakumariah, Subhash Publications
3. Polymer chemistry by V.R. Gowrikar , N.N. Vishwanathan and J. Sreedhar by Wiley eastern Ltd.
4. Corrosion engineering by M.G. Fontana, Tata McGraHill Publishing Pvt. Ltd
5. Introduction to Nanotechnology by Charles P. Poole Jr., Frank J. Owens Wiley India Publishers
6. Theory and practice in applied chemistry by O.P. Vermani and Narulla, New age International Publications
7. Vogel's text book of quantitative chemical analysis by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney.

<table>
<tr><td>Sub Code: BTBE15F2300</td><td rowspan="2">Basic Electronics Engineering</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To familiarize with the number systems, Boolean algebra and digital circuit design.
2. To understand the diode characteristics and its applications.
3. To learn the working principles of various electronic circuits.
4. To understand the transistor characteristics and its applications.
5. To compare the different biasing methods of transistors.
6. To understand the working of amplifiers and communication systems.
7. To understand the power electronic devices.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the student will be able to:
1. Design the digital circuits using various logic gates.
2. Analyze various diode circuits.
3. Work on various application based on electronic instruments.
4. Design of amplifier circuit based on BJT.
5. Demonstrate the working of amplifiers and the oscillators.
6. Analyze the various communication techniques.
7. Design Zener voltage regulator.</td></tr>
</table>

Course Contents

UNIT-I Digital Electronics and Number Systems **[14 hr]**

Digital Electronics: Introduction, Switching and Logic Levels, Digital Waveform. Number Systems: Decimal Number System, Binary Number System, Octal Number System, Hexadecimal Number System.

Number base conversions: Binary to Decimal, Decimal to Binary, Binary to Octal, Octal to Binary, Binary to Hexadecimal, Hexadecimal to Binary, Decimal to Octal, Octal to Decimal, Decimal to Hexadecimal, Hexadecimal to Decimal, Octal to Hexadecimal, Hexadecimal to octal. Complement of Binary Numbers. Binary addition, binary subtraction. Boolean Algebra Theorems, De Morgan's theorem. Digital Circuits: Logic gates, NOT Gate, AND Gate, OR Gate,NAND Gate, NOR Gate, XOR Gate, XNOR Gate. Algebraic Simplification, NAND and NOR Implementation NAND Implementation, NOR Implementation. Half adder and Full adder Implementations.

UNIT-II Semiconductor Diodes and Applications [14 hr]

p-n junction diode, Characteristics and Parameters, Diode approximations, DC load line analysis, Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit,Zener diode voltage regulators: Regulator circuit with no load, Loaded Regulator, Series and Shunt diode Clipping Circuits, Clamping Circuits: Negative and Positive Clamping Circuits, Numerical examples as applicable.

UNIT-III Bipolar junction Transistors [14 hr]

BJT configuration: BJT Operation, BJT voltages and currents, BJT amplification, Common Base, Common Emitter and Common Collector Characteristics, Numerical examples as applicable.

BJT Biasing: DC load line and Bias Point, Base Bias, Voltage divider Bias, Numerical examples as applicable.

UNIT-IV Electronic Devices and Applications [14 hr]

SCR, controlled rectifier-full bridge type. Oscillators and applications. OPAMP-summer, subtractor, integrator and differentiator, and typical applications in measurements.

Communication system, embedded system, cellular communication, satellite communication, remote sensing. (block diagram approach)

Text Books :

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
2. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

<table>
<tr><td>Sub Code: BTCC15F2400</td><td rowspan="2">Computer Concepts and C Programming</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The objective of this course is to:
1. Introduce the fundamentals of computer hardware and software.
2. Provide an understanding of problem solving with computers.
3. Introduce C programming language.
4. Provide a familiarization with the Unix programming environment.
5. Introduce problem solving through authoring and executing C programs.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">A student who successfully completes the course will have the ability to:
1. Use the basic terminology of computer programming;
2. Explain the different Unix commands, their usage and their syntax;
3. Write, compile and debug programs in C language;
4. Use different data types and operators in a computer program;
5. Design programs involving decision structures, loops and functions;
6. Use procedure calls by value and by reference;
7. Use arrays in applications like sorting and searching;
8. Handling strings;
9. Apply the C language knowledge to solve variety of problems.</td></tr>
</table>

Course Contents

UNIT-I Introduction to Computer System, Organization, Hardware and Software: [14 hr]

Definition of Computer, Early history, Structure of a computer, Information Processing life cycle, Essential computer hardware - Microprocessors, Storage media, Essential computer software, Types and Functions of operating systems, Number systems, Computer processing techniques, Networking.

UNIT-II Getting started with UNIX – Introduction and Commands: [14 hr]

Introduction to Unix Operating System, Introduction to Basic Command Format, Working with Files, Using the VI text editor, working with Files and Directories, Filename Substitution and Wild Cards, Standard Input, Output & Error, Pipes and redirection, Shell Commands.

UNIT-III Fundamentals of Problem Solving and Introduction to C Language: [14 hr]

Algorithms and Flow charts, Introduction to C Language – Background, structure of a C Program, Input / Output, Tips and common programming errors, Expressions and Statements, Branching constructs, Looping constructs.

UNIT-IV More towards C language: [14 hr]

Functions in C, Recursion, Arrays, Strings, Introduction to pointers.

Recommended Learning Resources:

1. Herbert Schildt, C: The Complete Reference, 4th Edition, Tata McGraw Hill
2. Sumitabha Das, UNIX Concepts and Applications, 4th Edition; Tata McGraw Hill
3. Reema Thareja, Computer fundamentals and programming in C.
4. Kernighan, Dennis Ritchie, The C Programming Language ,2nd edition, Englewood Cliffs, NJ: Prentice Hall, 1988

<table>
<tr><td>Sub Code: BTES15F2500</td><td rowspan="2">Environmental Sciences</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>1</td><td>1</td><td>0</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Gain knowledge on the components of environment and importance of environmental studies.
2. Understand the various types of energy and natural resources.
3. Acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of ecosystem.
4. Get knowledge about environmental pollution-sources, effects and control measures of environmental pollution.
5. Explore ways for protecting the environment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Analyze the environmental conditions and protect it.
2. Find new renewable energy resources.
3. Analyze the ecological imbalances and protect it.
4. List the causes of environmental pollution.
5. Design pollution controlled products.</td></tr>
</table>

Course Contents

UNIT-I Introduction: [14 hr]

Basic definitions, Objectives and Guiding principles of Environmental Studies, Components of Environment, Structures of atmosphere, Man-Environment relationship, Impact of Technology on the environment, sustainable environment, Environmental Protection - Role of Government, Initiatives by Non - Governmental Organizations (NGO).

UNIT-II Energy & Natural Resources: [14 hr]

Energy - Different types of energy, Electro-magnetic radiation. Conventional and Non-Conventional sources - Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative future source of Energy, Natural Resources- Water resources, Mineral Resources, Forest Wealth.

UNIT-III Ecology & Ecosystems: [14 hr]

Ecology- Objectives and Classification, Concept of an ecosystem - structure & function, Balanced ecosystem, Components of ecosystem - Producers, Consumers, Decomposers, Bio- Geo- Chemical Cycles & its Environmental significance (Carbon Cycle and Nitrogen Cycle), Energy Flow in Ecosystem, Food Chains: Types & Food webs Ecological Pyramids.

UNIT-IV Environmental Pollution: [14]

Introduction, Types, Concepts -Air Pollution, Water Pollution& Noise Pollution. Environmental Degradation- Global Warming, Green Houses Effects, Acid Rain, and Depletion of Ozone Layer.

Text books:

1. Benny Joseph (2005), “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited
2. Meenakshi P. (2006), “Elements of Environmental Science and Engineering”, Prentice Hall of India Private Limited, New Delhi
3. Rajagopalan R. (2005), “Environmental Studies – From Crisis to Cure”, Oxford University Press

Reference Books:

1. Raman Sivakumar, (2005), “Principles of Environmental Science and Engineering”, Second Edition, Cengage learning, Singapore
2. Ranjit Daniels R.J. and Jagdish Kirshnaswamy, (2009), “Environmental Studies”, Wiley India Private Ltd., New Delhi

3. Prakash S.M. (2007), “Environmental Studies”, Elite Publishers, Mangalore
4. ErachBharucha (2005), “Text Book of Environmental Studies”, for UGC, University Press
5. Tyler Miller Jr. G. (2006), “Environmental Science – Working with the Earth”, Eleventh Edition, Thomson Brooks/Cole
6. “Text Book of Environmental and Ecology” by Dr. Pratibha Sing, Dr. Anoop Singh and Dr. Piyush Malaviya. Acme Learning Pvt. Ltd., New Delhi.

Sub Code: BTCE17F2600	**Technical English II**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		2	1	1	0	3
Course Objectives	1. To equip learners with the ability to use language effectively in real-life scenarios. 2. To develop the learners’ competence in employability skills. 3. To inculcate the habit of writing leading to effective and efficient communication. 4. To emphasize specially on the development of technical reading and speaking skills among the learners of Engineering and Technology.					
Course Outcomes	On completion of the course, learners will be able to: 1. Express their opinions clearly and meaningfully. 2. Face interviews confidently. 3. Write accurately using different components of academic writing. 4. Draw inferences from the text; speak appropriately in social and professional contexts.					

Course Contents

Course Outline:
This is a 2 credit course for second semester consisting of 4 hours of teaching learning per week, inclusive of direct classroom teaching and practice in language lab.

Unit	Description	Evaluation Pattern	Topics	Teaching Hours
I	Language in Use	**25 Marks** Fill in the blanks/ MCQs	1. Vocabulary Building 2. Functional Words 3. Idioms & Phrasal Verbs 4. Homonyms & Homophones	16 Hours
II	Employability Skills	**25 Marks** Short Notes/ Descriptive Answers	1. Job Applications 2. Curriculum Vitae 3. Group Discussions 4. Presentation Skills 5. Role Plays 6. Interview Skills 7. Debates	16 Hours
III	Academic Writing	**25 Marks**	1. Essays	16 Hours

	– II	Short Notes/ Descriptive Answers	2. Letters 3. Dialogues 4. Proposals	
IV	Technical Speaking & Reading Skills	**25 Marks** Short Notes/ Descriptive Answers	1. Precis (Scientific Passages) 2. Public Speeches 3. Reading Manuals 4. Reading Scientific Reports 5. Interpreting Visual Materials	16 Hours

References:

1. Bansal, R.K. and J.B. Harrison. *Spoken English*. Orient Blackswan, 2013.
2. Raman, Meenakshi and Sangeeta Sharma. *Technical Communication*. Oxford University Press, 2015.
3. Thorpe, Edgar and Showick Thorpe. *Objective English*. Pearson Education, 2013.
4. Dixson, Robert J. *Everyday Dialogues in English*. Prentice Hall India Pvt Ltd., 1988.
5. Turton, Nigel D. *ABC of Common Errors*. Mac Millan Publishers, 1995.
6. Samson, T. (ed.) *Innovate with English.* Cambridge University Press, 2010.
7. Kumar, E Suresh, J. Savitri and P Sreehari (ed). *Effective English*. Pearson Education, 2009.
8. Goodale, Malcolm. *Professional Presentation*. Cambridge University Press, 2013.

<table>
<tr><td>Sub Code: BTED15F2700</td><td rowspan="2">Computer Aided Engineering Drawing</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>4</td><td>2</td><td>0</td><td>2</td><td>6</td></tr>
<tr><td>Preamble:</td><td colspan="6">Any Engineer, irrespective of his branch of specialization, has to have certain knowledge in order to design and manufacture any product for usage of society. One of the most important knowledge lies in Engineering Drawing. Engineers are a special class of professionals whoemploy the art and science of dreaming image as a means of communication. Engineering drawing is the primary medium forcommunicating design concepts and is an important tool for analyzing engineering problems. This course aims at developing the skills needed for documenting designs using drawings and for performing graphical analysis of two dimensional. Manual and computer aided methods of drawings and communication are covered.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Comprehend general projection theory, with emphasis on orthographic projection to represent in two-dimensional views (principal, auxiliary, sections).
2. Dimension and annotate two-dimensional engineering drawings.
3. Understand the application of industry standards and best practices applied in engineering graphics.
4. Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.
5. Introduction of CAD software for the creation of 2D engineering drawings.
6. The theoretical concepts delivered in this course would help the students to understand the sign considerations and tolerances to be used in the design and manufacture of engineering components.
7. This course will be very much basics for students to learn and wisely apply for the advanced Computer Aided Engineering (CAE) tools such as ABAQUS, ANSYS etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of the course, learners will be able to:
1. Develop independent thinking and problem solving capabilities.
2. Express component descriptions as per the commonly practiced standards.
3. Produce 2D and simple 3D drawings.
4. Comprehend industry specific drawings.
5. Converse through computer aided drawing any objects/tools/instruments/elements/ structures belonging to the entire engineering field.
6. Produce simple clear and illustrative drawings as per existing standards/conversations.</td></tr>
</table>

Course contents

UNIT-I Introduction to Drawing: **[14 hr]**

Introduction to Engineering Drawing: Introduction, Drawing Instruments and their uses, BIS conventions, Drawing sheets, Lettering, Dimensioning, Scales, regular polygons and its methods, tangents, ellipse, parabola, hyperbola, loci, cycloids, trochoids, epi and hypocycloids, spirals and involutes, helix, Co-ordinate system and reference planes.

Introduction to Software (solid edge):

Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools Creation of 2D/3D environment. Selection ofdrawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim,extend to next ,split, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line conventions, material conventions and lettering.

Orthographic Projection: Projection – Orthographic Projection – Planes of Projection – Four quadrants – First-angle projection – Third-angle projection – Reference line – Conventions employed.

Projection of points: Points in different quadrants.

Projection of Straight Lines (First-angle Projection only): Parallel to one or both planes – Contained by one or both planes – Perpendicular to one plane and parallel to other plane – Inclined to one plane and parallel to the other – Inclined to both planes.

Projection of Planes: Types of Planes – Perpendicular Planes – Oblique Planes – Projection of Planes - Parallel to one Plane – perpendicular to both planes – perpendicular to one inclines to other – Oblique planes (only change of position method).

UNIT-II Projection of Solids: **[14 hr]**

Polyhedra (Cube – Tetrahedron - Prisms and Pyramids) – Solids of revolution(Cone andCylinder) – Solids in simple position – Axis perpendicular to a plane – Axis parallel to both planes – Axis parallel to one plane and inclined to the other – Axis inclined to both plane (only change of position method).

UNIT-III Sections of Solids: **[14 hr]**

Section Planes – Sections – True Shape of Section – Sections of Prisms – Sections of Pyramids – Sections of Cylinders – Section of Cones. Developments of Lateral Surfaces of Solids - Polyhedra (Cube – Tetrahedron - Prisms and Pyramids) – Solids of revolution (Cone andCylinder) and their Frustums.

UNIT-IV Isometric Projection: **[14 hr]**

Isometric axes - Lines and Planes – Isometric Scale – Isometric Projection of Planes – Prisms – Pyramids – Cylinders – Cones – Spheres - Hemi-Spheres - frustums - Combination of Solids (Maximum Three). Conversion of Orthographic Drawing to Isometric View / Pictorial Drawing of a simple Machine Components. Application Drawings: Civil drawing (building plans), electrical symbols and circuits, electronic symbols and circuits and simple assembly drawing (bolt and nut).

Text Books:

1. Engineering Drawing – N.D.Bhatt and V.M. Panchal, 48th Edition, 2005 – Charotar Publishing House, Gujarat.
2. A Primer on Computer Aided Engineering Drawing-2006, Published by VTU, Belgaum.
3. Computer Aided Engineering Drawing by Dr Balaveer Reddy and Co authors, CBS Publications, 2014

Reference Books:

1. Engineering Graphics - K.R. Gopalakrishna, 32nd Edition, 2005 – Subhas Publishers, Bangalore.
2. Engineering Drawing – P. S. Gill, 11th Edition, 2001 – S. K. Kataria & Sons, Delhi.

E-Material:

1. **Computer Aided Engineering Drawing- Vol. I,** (PPT) by Dr. Rajashekar Patil and Prof Gururaj Sharma T

<table>
<tr><td>Sub Code: BTCL15F2800</td><td rowspan="2">Engineering Chemistry Lab</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="6">To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">1. On completion of lab course students will have the knowledge in;
2. Handling different types of instruments for analysis of materials for better accuracy and precision
3. Carrying out different types of titrations for quantitative estimations of materials</td></tr>
</table>

Course contents

LAB EXERCISES

1. Potentiometric estimation of FAS using standard K2Cr2O7.
2. Conduct metric estimation of an acid mixture using standard NaOH solution.
3. Determination of pKa of a weak acid using pH meter.
4. Determination of molecular weight of given polymer sample using ostmail’s Viscometer.
5. Colorimetric estimation of copper.
6. Determination of COD of the given industrial waste water sample.
7. Determination of total and temporary hardness of water using disodium salt of EDTA.
8. Estimation of alkalinity of given water sample using standard HCl solution.
9. Determination of Iron in the given haematite ore solution using potassium dichromate.
10. Determination of calcium oxide in the given sample of cement by rapid EDTA method
11. Flame photometric estimation of sodium in the given sample of water.
12. Electroplating of copper and nickel.

<table>
<tr><td>Sub Code: BTCP15F2900</td><td rowspan="2">Computer Programming Lab</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration : 14 Wks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Introduce the Basic Principles of Problem Solving using a Computer;
2. Present and Provide the Programming Constructs of ‘C’Programming Language;
3. Provide the skills required to Design, Demonstrate and Implement Computable Problems / Mini-projects / Projects using ‘C’ Programming Language;
4. Provide the Arena for Development of Analytical, Reasoning and Programming Skills;
5. Set the Strong Foundation for Software Development in the field of Programming and hence to Create high quality ‘C’ Professionals.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completion of this course, the students would be able to:
1. Understand the Basic Principles of Problem Solving
2. Study, understand and identify the Representation of Numbers, Alphabets and other Characters in the memory of Computer System
3. Understand Analyze, Integrate, Apply and Demonstrate Software Development Tools; like Algorithms, Pseudo Codes and Programming Structures.
4. Study, Understand, Analyze and Categorize the logical structure of a Computer Program, and hence to Apply different programming constructs to develop a Computer Program using ‘C’ Programming Language.
5. Offer Engineering Solutions to simple (moderate) mathematical and logical problems using ‘C’ Programming Language.
6. Study, Understand, Analyze, Integrate, Classify, Compare and Apply simple Data Structures, Pointers, Memory Allocation and Data Handling through files using ‘C’ Programming Language.
7. Understand and identify the working of different Operating Systems; like Windows and Linux.
8. Enhance their Analytical, Reasoning and Programming Skills.</td></tr>
</table>

Course contents

1. Unix Commands – execution and learn extra options than what is taught in theory
2. How to edit, compile and execute a C program on UNIX using editors like G-edit, K-write, writing a shell program.
3. Programs on data types, operators, expressions
4. Conditional statements – simple if statement, if-else statement, nested if-else, else-if ladder, switch statement

5. Looping statements – for, while and do-while statements
6. Arrays – 1-D and 2-D arrays
7. Programs on Sorting and searching
8. User defined Functions – pass by value, pass by reference, passing arrays to functions
9. Strings – finding length, string concatenation, string compare, substring search, palindromes etc
10. Programs on pointers.

Recommended Learning Resources:

1. Herbert Schildt, C: The Complete Reference, 4th Edition, Tata McGraw Hill
2. Sumitabha Das, UNIX Concepts and Applications, 4th Edition; Tata McGraw Hill
3. Reema Thareja, Computer fundamentals and programming in C.
4. Kernighan, Dennis Ritchie, The C Programming Language ,2nd edition, Englewood Cliffs, NJ: Prentice Hall, 1988
5. http://c-faq.com/index.html
6. Paul Deitel, C How to Program, 7th Edition, Deitel How to Series.

Sub Code:BTEE15F3100	Engineering Mathematics – III	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Probability, random variables and Sampling distributions in various fields of engineering.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems					

COURSE CONTENTS

UNIT-I Numerical Method – I **[14 hr]**

Numerical Solution of algebraic and transcendental equations: Regula-falsi method, Newton - Raphson method. Iterative methods of solution of a system of equations: 2 Gauss-seidel and Relaxation methods.

Finite differences and Interpolation :-Forward and Backward differences , Newton's forward and Backward interpolation formulae, Divided differences-Newton's divided difference formula, Lagrange's Interpolation formula and Inverse Interpolation formula and Problems.

UNIT –II Numerical Method – II **[14 hr]**

Numerical Differentiation and Integration:- Derivatives using Newton's forward and backward difference formula. Trapezoidal Rule, Simpson's $1/3^{rd}$, $3/8^{th}$ Rule, Weddle's formula and Problems.
Linear Programming : Mathematical Formulation of Linear Programming Problem(LPP) , Simplex Method , BigM method

UNIT-III Probability Theory – I **[14 hr]**

Introduction of Probability, Probability associated with set theory, addition law, conditional Probability, multiplication law, Baye's Theorem.

Random variables (discrete and continuous), Probability density function, probability distribution – binomial and Poisson's distributions; exponential and normal distributions.

UNIT-IV Probability Theory – II **[14 hr]**

Sampling theory:-Sampling, Sampling distributions, standard error, test of hypothesis for means and confidence limits for means and distributions and Chi-square distributions.

Joint Probability distribution and Markov's chains:-Concept of joint probability, joint distributions –discrete random variables, independent random variables, problems on expectationand variance.

Markov's chains-Introduction, probability vectors, stochastic matrices, fixed points and regular stochastic matrices, Markov's chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 42nd edition, 2013.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2012.
3. K S Trivedi "Probability and Random processing".

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 1st edition, 2010.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 4th edition, 2002.

Sub Code:BTEE15F3200	**Electrical Circuit Theory- I**	**C**	**L**	**T**	**P**	**CH**
Duration:14Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To show the characteristics of basic network elements and to demonstrate the applications of loop and mesh analysis as well as of network reduction techniques. 2. To illustrate the concept of network theorems 3. To describe the constituents of two port network. 4. To discuss the concept of resonance. 5. To adopt graph theory for network reduction and analysis					
Course Outcomes	After the completion of the course the student will be able to: 1. Reduce given three phase networks using star delta transformation 2. Solve typical network problems using standard network theorems 3. Represent the given network in terms of two-port network 4. Formulate mathematical equations in matrix form through solve typical network problems using standard network theorems					

COURSE CONTENTS

UNIT- I Basic Concepts **[12 hr]**

Basic definitions. Practical sources, Source transformations, Network reduction using Star – Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.

UNIT- II Network Theorems [12 hr]

Superposition, Reciprocity and Millman's theorems, Thevenin's and Norton's theorems, Maximum Power transfer theorem

UNIT- III Two Port Network Parameters and Resonant Circuits [12 hr]

Definition of z, y, h and transmission parameters, modeling with these parameters and relationship between parameters sets. Problems. Driving point function and transfer function, Problems. Series and parallel resonance, frequency-response of series and parallel circuits, Q factor, Bandwidth.

UNIT- IV Network Topology [12 hr]

Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set and cut-set schedules, Formulation of equilibrium equations in matrix form, solution of resistive networks and principle of duality.

Text Books:

1. Engineering Circuit Analysis, Hayt, Kemmerly and Durbin, TMH, 7th Edition, 2010.
2. Networks and systems, Roy Choudhury, New Age International Publications.,2nd Edition, 2006 re-print,

Reference Books:

1. Electric Circuits, Schaum's Outlines, M Nahvi & J A Edminister, TMH, 5th Edition, 2009.
2. Network Analysis, M. E. Van Valkenburg, PHI, 3rd edition, reprint 2009.
3. Analysis of Linear Systems, David K. Cheng, Narosa Publishing House, 11th reprint, 2002
4. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N. O. Sadiku

<table>
<tr><td>Sub Code:BTEE15F3300</td><td rowspan="2">Electrical & Electronic Instrumentation and Measurements</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration :14 Wks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide basic knowledge about Measuring units of physical parameters.
2. To describe the principles of various measuring instruments
3. To equip students with basic concepts of different Electrical transducers used in process control.
4. To enable students with necessary mathematical skills for instruments' measurement range</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. 1.Adoptvarious units associated with physical parameters
2. Select instruments for measurements based on the electrical parameters to be measured.
3. Describe the operation of measuring instruments
4. Decide a type of transducer for any particular application.</td></tr>
</table>

COURSE CONTENT

UNIT- I Measurement of Resistance, Inductance and Capacitance [11 hr]

Wheat stone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance, measurement by fall of potential method and by using Insulation tester (Megger). Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance &capacitance bridge, Schering bridge. Shielding of bridges. Problems

UNIT- II Transducers &Display Devices, Signal Generators [11 hr]

Classification and selection of transducers. Strain gauges. Measurement of temperature and pressure. Photo-conductive and photo-voltaic cells. , X-Y recorders. LCD and LED technology. Signal generators and function generators.

UNIT- III Electronic Instruments [11 hr]

Introduction. True RMS voltmeter. Electronic multimeters. Digital voltmeters. Q meter.
Dual trace oscilloscope — front panel details of a typical dual trace oscilloscope. Method of measuring voltage, current, phase, frequency and period. Use of Lissajous patterns. Working of a digital storage oscilloscope. Brief note on current probes ,clamp on meters/ tong testers

UNIT- IV Measurement of Power and Energy [11 hr]

Dynamometer wattmeter. UPF and LPF wattmeters, Measurement of real and reactive power in three-phase circuits. Principle of working of electronic tri-vector energy meter/Static Energy meter. Construction and operation of electro-dynamometer single-phase power factor meter. Weston frequency meter and phase sequence indicator. Smart metering system – AMR, e.g.: prepaid meter, ToD meter etc.

Text Books :

1. A. K. Sawhney, Dhanpatrai and Sons, "Electrical and Electronic Measurements and Instrumentation", New Delhi.
2. Cooper D. and A.D. Heifrick, "Modern Electronic Instrumentation and Measuring Techniques", PHI, 2009 Edition.

Reference Books:

1. David A. Bell , "Electronic Instrumentation and Measurement", oxford Publication ,2nd Edition, 2009.
2. Golding and Widdies, Pitman ,"Electrical Measurements and Measuring Instruments".

Sub Code:BTEE15F3400	Electrical Power Generation	C	L	T	P	CH
Duration :14 Wks		4	3	1	0	5
Course Objectives	1. To provide an awareness of various conventional and non-conventional energy resources and also of principle of their conversion process into electrical energy. 2. To provide fundamental concepts about Power plant structure, operation and control. 3. To equip the students with basic concepts of Substations, Grounding systems and economic aspects. 4. To provide basis for further study of both conventional and Non-Conventional Energy resources					
Course Outcomes	On completion of this course the students will be able to: **1.** Compare the relative merits and limitations of available Energy Sources. **2.** Interpret the values of various factors influencing the economic aspects of a power system **3.** Recognize the role of Substation and the fundamentals of Grounding systems. **4.** Estimate the energy cost from the given tariff.					

COURSE CONTENT

UNIT- I Sources of Electrical power and Power Generation-1 **[11 hr]**

Introduction: Fuel cell, tidal, geo-thermal, bio-generation, Concept of co-generation (waste heat recovery), Concept of distributed generation.(only block diagram approach)
Hydro Power Generation: Classification of hydro-electric plants, Mini-generation, micro-generation. General arrangement and operation. Selection of site, hydroelectric plant power station structure, control and Layout. Merits and demerits.
Wind Power Station: General arrangement and operation. Selection of site. Power station structure, control and Layout. Merits and demerits

UNIT- II Power Generation-2 **[11 hr]**
Solar Power Generation: General arrangement and operation. Selection of site. Power station structure, control and Layout, solar photovoltaic-grid integration. Merits and demerits
Nuclear Power Station: Pros and cons of nuclear power generation. Selection of site, cost, components of reactors, Types of reactors, Description of fuel sources. Safety of nuclear power reactor. Merits and demerits
Thermal Power Generation: General arrangement and operation, coal, gas and diesel, Selection of site. Power station structure, control and Layout. Merits and demerits, Concepts of Solar-thermal power generation.

UNIT- III Economics Aspects **[11 hr]**

Introduction: Terms commonly used in system operation. Diversity factor, load factor, plant capacity factor, plant use factor, plant utilization factor and loss factor, load duration curve. Cost of generating station. Numericals.
Tariff: Factors influencing the rate of tariff designing, types of tariff**.** Generation-tariff, end user-tariff. Power factor improvement. Numericals.

UNIT- IV Substations and Grounding Systems [11 hr]
Substations: Introduction, types, Bus bar arrangement schemes, Location of substation equipment. Reactors and capacitors. Interconnection of power stations
Grounding Systems: Introduction, grounding systems. Neutral grounding. Ungrounded system. Resonant grounding. Solid grounding, reactance grounding, resistance grounding. Earthing transformer. Neutral grounding transformer. Substation earthmat design – IEEE 80-2000.

Text Books:

1. A. Chakrabarti, M. L. Soni, and P.V. Gupta**," Power System Engineering",** Dhanpat Rai and Co., New Delhi.
2. S. N. Singh, PHI, **"Electric Power Generation, Transmission and Distribution",** 2nd Edition, 2009.
3. M. V. Deshpande**," Elements of Electrical Power System Design"**, PHI,2010
4. E.L-Wakil, "Power plant Technology", International Edition 1984, McGraw Hill book company, Singapore.
5. G.D. Rai, "**Non-Conventional Energy Sources** ", Published in 2011 by Khanna Publishers.

Reference Books:

1. Ajith Krishnan R, Jinshah B S, "**Magneto hydrodynamic Power Generation**" International Journal of Scientific and Research Publications, Volume 3, Issue 6, June 2013
2. Allen J wood & Wollenberg, "**Power generation, operation and control**", John Wiley and Sons, 2^{nd} Edition.

Sub Code:BTEE15F3500	**Analog Electronics Circuit Design**	**C**	**L**	**T**	**P**	**CH**
Duration : 14 Wks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To provide an insight into the modeling of semiconductor diodes, bipolar junction transistors and their applications in the design and analysis of clippers, clampers, amplifiers and oscillators. 2. To illustrate the necessary biasing techniques of transistors. 3. To familiarize students with transistor characteristics in Common Collector, Common Base and Common Emitter Mode. 4. To enable students with the concept of positive feedback applied in oscillators. 5. To inculcate the skills of analyzing BJT amplifiers to compare their performance parameters.					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the operation, applicat ions and characteristics of devices including diodes and BJT. 2. Analyze and design circuits such as rectifiers, clippers, clampers,					

	amplifiers and oscillators. 3. Develop the capability to analyze and design simple circuitscontaining non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis. 4. Apply the concepts of both positive and negative feedback in electronic circuits. 5. Design circuits and analyze experimental results in the laboratory

COURSE CONTENTS

UNIT- I Diode Circuit **[11 hr]**

Diode Resistance, Diode equivalent circuits, Transition and diffusion capacitance, Reverse recovery time, Load line analysis.
Applications: Rectifiers, Clippers (series and shunt types, biased) and clampers (positive and negative, biased)

UNIT- II Transistor biasing **[11 hr]**

DC load line – Q point effect on signal swing – different biasing techniques Bias stability – stability factors
Transistor Amplifiers and frequency response: BJT transistor modeling (re and h models) for various CE configurations (fixed bias, voltage divider bias and emitter bias) , Small signal BJT amplifiers:- analysis of CE configuration using re-model, h- parameter model; emitter follower, boot strapping, Miller effect, gain bandwidth product.

UNIT- III **[11 hr]**

General amplifiers, feedback amplifiers & power amplifiers

General amplifiers Darlington connections
Feedback Amplifiers: - Characteristics of feedback, feedback topologies, Ideal Analysis of feedback amplifiers.
Power amplifiers: - classification and application, series fed class A amplifier, Transformer coupled Class A amplifiers, Class B Push-Pull amplifiers:- Complementary Push-Pull and Transformer–coupled load Push-Pull, Amplifier distortions.

UNIT- IV Oscillators **[11 hr]**

Principle of operation (Barkhausen's Criteria, positive feedback concept), Audio frequency Oscillators, Radio frequency Oscillators , Crystal Oscillators. (BJT Version Only)

Text books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", PHI/Pearson Education. 9th Edition.
2. Albert Malvino, "Electronic principles", 8th Edition, McGraw-Hill Higher Education.

Reference books:

1. Jacob Millman & Christos C. Halkias , "Integrated Electronics", Tata - McGraw Hill, 2nd

Edition, 2010.
2. David A. Bell, “Electronic Devices and Circuits”, PHI, 5th Edition, 2009.
3. Muhammad H. Rashid, “Electronic Circuits and Applications”, Cengage learning, 1st Edition
4. Muhammad H. Rashid, “Electronic Devices and Circuits”, Cengage Learning, 1st Edition

Sub Code:BTEE15F3600	**Digital Electronic Circuit Design**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Wks		**3**	**2**	**1**	**0**	**4**
Course Objectives:	1. Illustrate Boolean laws and systematic techniques for minimization of expressions. 2. Demonstrate the methods for simplifying Boolean expressions also familiarize the commonly used terms like minterm, canonical expression, SOP etc. 3. Introduce the Basic concepts of combinational and sequential logic. 4. Present real world examples for making the learners attuned to Logic concepts. 5. Introduce the concept of memories, programmable logic devices and digital ICs.					
Course outcomes	At the end of this course, student will be able to: 1. Define a Boolean term, expression, SOP, POS, Minterm etc. 2. Construct the K-map from a Boolean expression and to find the minimal SOP/POS forms. 3. Determine the output and performance of given combinational and sequential circuits 4. Design arithmetic and combinational logic circuits using gates, encoders, decoders, multiplexers and de-multiplexers. 5. Design specified synchronous or asynchronous sequential logic circuits using appropriate flip flops.					

COURSE CONTENTS

UNIT- I Principle and Minimization Techniques of combinational Circuits [11 hr]

Introduction to combinational logic circuits, generation of switching equation from truth table. Minimization Techniques: Boolean postulates and laws, De-Morgan’s Theorem, Boolean algebra, expression minimization. Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), Karnaugh map (3, 4, 5 Variable) and Quine - McCluskey method of minimization

UNIT- II Analysis and Design of Combinational Circuits [11 hr]

Design procedure of Half adder, Full Adder, Half subtractor, Full subtractor, Carry Look Ahead adder, BCD adder, Comparator – 1bit and 2 bit , Principle of Encoder and Decoder with cascading of decoders. Principle of Multiplexers and Demultiplexer with cascading of Mux and Boolean function implementation using Mux and decoders.

UNIT- III Introduction to Sequential circuits [11 hr]

Basic bistable element, S R Latch , application of SR latch as a switch debouncer, Edgetriggering – Level Triggering, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation. Registers, Shift Register, Universal shift register, Counters: Binary Ripple Up/Down Counter, Design of synchronous Mod- n counter using flip-flop.

UNIT- IV Sequential Circuits' Design & Logic Families [11 hr]

Sequential Design: Introduction to Mealy and Moore Model circuits. State machine notation, Synchronous sequential circuit analysis and construction of state table and diagram.

Logic families: Diode-Transistor Logic, Transistor-Transistor Logic, Emitter-Coupled Logic, NMOS and PMOS Logic, CMOS Logic.

Text Books:

1. John M Yarbrough, "**Digital Logic Applications and Design**", Thomson Learning, 1st Edition, 2001.
2. Donald D Givone, "**Digital Principles and Design**", Tata McGraw-Hill 1st Edition, 2002.

Reference books:

1. D P Leach, A P Malvino, & Goutham Saha, " **Digital Principles and applications**", Tata McGraw-Hill, 7th Edition, 2010.
2. Moshe Morris Mano, "**Digital Design**" Prentice Hall, 3rd Edition, 2008.
3. Samuel C Lee, " **Digital Circuits and Logic Design**" ,PHI learning, 1st Edition, 2009
4. Chales H Roth, Jr., "**Fundamentals of Logic Design**", Cengage learning, 5th Edition, 2004

<table>
<tr><td>Sub Code:BTEE15F3700</td><td rowspan="2">Analog Electronic Circuit Design Laboratory</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration :14 Wks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable students to identify the various electronic components To enable students to verify theoretical analysis with experimental results.
2. To enable students to conduct experiments, collect results, interpret results and analyze any discrepancies</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Students will be able to
1. Rig circuit as per the circuit and conduct experiments.
2. Demonstrate the ability to design circuits for a given specification and to choose appropriate instruments for measurements.
3. Become adept at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, KVL and KCL, voltage and current dividers and the node method.
4. Analyze and design simple electronic circuits such as rectifiers, clippers, clampers, amplifiers and oscillators.
5. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.
6. Interpret the obtained experimental results
7. Present the results in a professional manner.
.</td></tr>
</table>

List of lab experiments:

1. Design and Testing of Diode Clipping (Single and Double ended) circuits.
2. Design and Testing of Clamper Circuits (Positive and Negative Clamping).
3. Design of RC coupled Single stage BJT amplifier and determination of the gain-frequency response, input and output impedances.
4. Design of BJT Darlington Emitter Amplifier and determination of the gain frequency response and input /output impedance.
5. Design and testing of BJT R-C Phase shift Oscillator.
6. Design and testing of BJT Hartley and Colpitt's Oscillators.
7. Design of Rectifier Circuits with and without capacitor filter. Determination of ripple factor, regulation and efficiency.
8. Design of Class-B Push-Pull Amplifier and determination of its conversion efficiency.
9. Study of Crystal Oscillator.
10. Study of Voltage series feedback amplifier and determination of the gain, Input and output Impedance.

<table>
<tr><td>Sub Code:BTEE15F3800</td><td rowspan="2" colspan="1">Digital Electronic Circuit Design Laboratory</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration :14 Wks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course Objectives:</td><td colspan="6">1. To enable students to identify the various electronic components like logic gates
2. To enable students to verify theoretical analysis with experimental results
3. To enable students to conduct experiments, collect results, interpret results and analyze any discrepancies.</td></tr>
<tr><td>Course outcomes</td><td colspan="6">At the end of this course, Student will be able to:
1. Define a Boolean term expression, SOP, POS, Minterm etc.
2. Contrast and differentiate combinational and sequential circuits.
3. Express real world reasoning problems in terms of logic expressions.
4. Apply systematic techniques for reducing Boolean Logic expressions.
5. Develop Logic Circuits to satisfy requirements of the problem statement.
6. Analyze given logic circuit to deduce the real world problem it is implementing.
7. Assemble basic elements like gates to design basic memory elements called flip flops.
8. Design and develop advanced sequential entities like registers and counters.</td></tr>
</table>

List of lab experiments:

1. Simplification, realization of Boolean expressions using logic gates/universal gates.
2. Realization of Half/Full adder and Half/Full Subtractors using logic gates.
3. (i) Realization of parallel adder/Subtractors using7483 chip (ii) BCD to excess-3 code conversion and vice-versa.
4. Realization of Binary to Gray code conversion and vice-versa.
5. Realization of One/Two bit comparator and study of 7485 magnitude comparator.
6. Use of a) Decoder chip to drive LED display and b) Priority encoder.
7. Use of a) Decoder chip to drive LED display and b) Priority encoder.
8. Truth table verification of Flip-Flops: (i) JK Master Slave (ii) T-Type and (iii) D Type
9. Realization of 3 bit counters as a sequential circuit and MOD – N counter design (7476, 7490, 74192, 74193).
10. Shift left; Shift right, SIPO, SISO, PISO, PIPO operations using 74S95.
11. Wiring and testing Ring counter/Johnson counter.
12. Wiring and testing of Sequence generator.

IVSemester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F4100	Engineering Mathematics – IV	HC	4	3	1	0	5
2	BTEE15F4200	Electrical Circuit Theory- II	HC	3	2	1	0	4
3	BTEE15F4300	Electromagnetic Theory	HC	3	2	1	0	4
4	BTEE15F4400	Electrical Machines I	HC	3	2	1	0	4
5	BTEE15F4500	Microcontrollers and Applications	HC	3	2	1	0	4
6	BTEE15F4600	Power Electronics	HC	3	2	1	0	4
7	BTEE15F4700	Microcontroller Laboratory	HC	2	1	0	1	3
8	BTEE15F4800	Power Electronics Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**23**	**15**	**6**	**2**	**31**

Sub Code:BTEE15F4100	**Engineering Mathematics –IV**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	To study and understand the application approach of the concepts of Numerical methods, Fourier transforms, Z-transforms and Complex variables.					
Course Outcomes	After the completion of the course the student will be able 1. To understand the basics of numerical methods and their applications. 2. To solve the problems of Probability and statistics in various engineering fields. 3. To apply the numerical methods and Sampling Theory concepts to solve various engineering problems.					

COURSE CONTENTS

Unit –I **(13 hours)**

Numerical Methods –III: (i) Numerical solution of simultaneous first order ODE :Picard's and Runge-Kutta method of fourth order.

(ii) Numerical solution of second order ordinary differential equations, Picards method, Runge-Kutta method and Milne's method

(iii) Numerical solutions of PDE: Finite difference approximations to derivatives, Numerical solution of two –dimensional Laplace equation, one-dimensional Heat and Wave Equations.

Unit –II **(13 hours)**

Fourier series and Transforms :Convergence and divergence of infinite series of positive terms , definition and illustrative examples, periodic functions, Dirichlet's conditions and Fourier series of period functions of period 2π and arbitrary period , half range Fourier series , Complex form of Fourier series and Practical Harmonic analysis.

Infinite Fourier Transform, Fourier sine and cosine transforms, properties,inverse transforms.

Unit-III **(13 hours)**

Z-transforms and special functions :Z-Transforms- Definition, standard Z-transforms , damping rule, shifting rule , initial value and final value theorems , inverse Z-transform , application of Z-transform to solve difference equations.

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind, Series solution of Legendre's differential equation leading toLegendre polynomials, Rodrigue's formula.

Unit-IV **(13 hours)**

Complex variables –I & II

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Propertie of analytic functions.

Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.

Conformal Transformations: Bilinear Transformations. Discussion of Transformations:$w = z^2$, $w = e^z$, $w = z + (a^2 / z)$,Complex line integrals-Cauchy's theorem and Cauchy's integral formula

Text books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publications, 10th edition, 2015.

Reference Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2014.

<table>
<tr><td>Sub Code:BTEE15F4200</td><td rowspan="2">Electrical Circuit Theory- II</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration:14Weeks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To teach the importance of dot convention in coupled circuits.
2. To establish the role of initial conditions in transient analysis.
3. To make use of tools like Fourier series, Laplace Transform and state variable techniques in analyzing circuits.
4. To provide basic knowledge of network synthesis and realization of filters.
5. To provide an insight into frequency plots.</td></tr>
<tr><td>Course outcomes</td><td colspan="6">1. Able to develop KVL equations for the coupled circuits.
2. Able to apply Fourier series and Laplace Transform Techniques for typical network problems
3. Able to express state variables in terms of circuit parameters.
4. Able to realize networks out of network functions</td></tr>
</table>

COURSE CONTENTS

UNIT – I Coupled Circuits and Initial Conditions **[11 hr]**

Mutual inductance, coupling coefficient, analysis of coupled coils, dot rule, conductively coupled equivalent circuits, problems.
Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL,RC and RLC circuits for AC and DC excitations.

UNIT – II Application of Fourier series and Laplace Transform **[11 hr]**

Introduction to trigonometric Fourier series, Exponential Fourier series, Waveform symmetry, Effective values and power, applications in circuit analysis, Fourier transform of non periodic waveforms,

Introduction to Laplace transformation, step, ramp and impulse functions, gate function, Laplace transform of periodic functions, solution of network problems, waveform Synthesis. Application of Convolution theorem and Convolution integral, impulse response, Initial value and final value theorems.

UNIT – III State Variable Analysis **[11 hr]**

Introduction, state variable approach, state space representation, transfer function, linear transformation, diagonalization, state transition matrix, solution to non homogeneous state equations, minimal set of state variable formulation.

UNIT – IV Synthesis and Frequency response **[11 hr]**

Passive network synthesis: Realizing a reactance network-Foster and Cauer forms
Attenuators: Introduction, Nepers, Decibels, T-type attenuator, π-type attenuator, insertion loss.
Frequency response plots: Introduction, plots from s-plane phasors, polar plot, problems.

Textbooks:

1. Roy Choudhury, “Networks and systems”, New Age International Publications., 2nd Edition, 2006 re-print.

2. Charles K. Alexander and Matthew N. O. Sadiku, “Fundamentals of Electric Circuits”.
3. David K. Cheng,” Analysis of Linear Systems”, Narosa Publishing House, 11th reprint, 2002.

Reference books:

1. Hayt, Kemmerly and Durbin ,”Engineering Circuit Analysis”, TMH ,7th Edition,2010.
2. M. E. Van Valkenburg ,“Network Analysis”, PHI, 3rd edition, reprint 2009.
3. Schaum’s Outlines, M Nahvi & J A Edminister, “Electric Circuits”, TMH, 5th Edition, 2009

Sub Code:BTEE15F4300	**Electromagnetic theory**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To study the basic concepts of vector calculus and co-ordinate system. 2. To discuss the concept of potential and energy density in the case of static and time varying fields. 3. To discuss the concepts of Coulomb’s law and Gauss law and their applications. 4. To study the concept of the steady magnetic field, magnetic materials and inductance calculation. 5. To provide the knowledge of time varying field and Maxwell’s equations.					
Course Outcomes	After the completion of the course the student will be able to: 1. Able to understand the concepts of vector calculus and co-ordinate system. 2. Able to understand the concept of potential and energy density in the case of static and time varying fields. . Able Coulomb’s law and Gauss law and their applications in real world applications. 3. Able to understand the steady magnetic field, magnetic materials and inductance calculation 4. Investigate the electromagnetic phenomenon in a time varying electric and magnetic fields.					

COURSE CONTENTS

UNIT-I **[11 hr]**

Coulomb’s Law and electric field intensity: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge.
Electric flux density, Gauss’ law and divergence: Electric flux density, Gauss’ law, Divergence, Maxwell’s First equation (Electrostatics), vector operator ∇ and divergence theorem.

UNIT-II **[11 hr]**

Energy and potential : Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge and system of charges, Potential gradient , Energy density in an electrostatic field.
Conductors, dielectrics and capacitance: Current and current density, Continuity of current, metallic conductors, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, capacitance and examples.
Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solutions of Laplace's and Poisson's equations

UNIT-III **[11 hr]**

The steady magnetic field: Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.
Magnetic forces: Force on a moving charge and differential current element, Force between differential current elements, Force and torque on a closed circuit.

UNIT-IV **[11 hr]**

Magnetic materials and inductance: Magnetization and permeability, Magnetic boundary conditions, Magnetic circuit, Potential energy and forces on magnetic materials, Inductance and Mutual Inductance.
Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equation in point and Integral form, retarded potentials.

Text books:
1. William H Hayt Jr. and John A Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 7^{th} edition, 2006

Reference Books:
1. John Krauss and Daniel A Fleisch, "Electromagnetics with Applications"**,** McGraw-Hill, 5^{th} edition, 1999
2. Edward C. Jordan and Keith G Balmain, "Electromagnetic Waves And Radiating Systems," Prentice – Hall of India / Pearson Education, 2^{nd} edition, 1968.Reprint 2002
3. David K Cheng, "Field and Wave Electromagnetics", Pearson Education Asia, 2^{nd} edition, -1989, Indian Reprint – 2001

Sub Code:BTEE15F4400	**Electrical Machines - I**	**C**	**L**	**T**	**P**	**CH**
Duration :16 weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To enable the students to familiarize with the theory, construction, classifications and working principle of transformers and Induction motors 2. To enable to learn the necessity of different tests conducted and the parallel operation on single phase transformers 3. To enable to study the Classification and different connections of three phase Transformers 4. To enable to draw equivalent circuit & circle diagram for the					

	performance Analysis of three phase induction motor. 5. To enable to understand the necessity of starters & speed control for 3 phase IM
Course Outcomes	On the successful completion of this course, the student is expected to be able to: 1. Reveal their knowledge and understanding of electromechanical energy conversion in Transformers and Induction machines. 2. Analyze the concepts of fundamental torque equation and rotating fields 3. Analyze the fundamental characteristics of Transformers and Induction machines. 4. Interpret experimental results and correlate them with theoretical predictions.

COURSE CONTENTS

UNIT – I Single phase transformers **[11 hr]**

Introduction, Construction and Principle of transformer, operation of ideal, practical transformer at no load and on load, phasor diagram, voltage current and power relations. Exact and approximate equivalent circuits. Transformer losses, efficiency, regulation and conditions. o c & s c test on transformer, sumpner's test. Parallel operation of transformers. Auto-transformer in brief and relevant problems

UNIT – II Three phase transformers **[11 hr]**

Introduction to 3-Phase transformers, three phase transformer connections. .Exact andapproximate per phase equivalent circuit; phasor diagram under no load and loaded conditionand relevant problems. Open Delta connections, V connections

UNIT – III Induction machines **[11 hr]**

Introduction to single phase& three phase induction motor, constructional details of 3 ph. induction motor, three phase rotating magnetic field. Exact and approximate per phase equivalentcircuit; phasor diagram under no load and loaded condition. Power flow diagram in a three phaseinduction machine, air gap power, slip power, mechanical power; torque-slip and current-slip characteristics. Starting torque, breakdown slip, breakdown torque, maximum mechanical power, effect of equivalent circuit parameters and relevant problems. Introduction to Induction Generators

UNIT – IV Testing of three phase induction machines **[11 hr]**

No load and blocked rotor tests for determining equivalent circuit parameters; losses and efficiency. Induction machine performance computation from circle diagram. Cogging torque and crawling; induction machines with deep bar and double cage rotors and relevant problems. Direct on line starting, rotor resistance based starting. Star/delta and auto transformer based starting. Speed control of induction motors by stator voltage variation and pole changing techniques. Variable frequency speed control of induction machines, v/f control method, slip power control method and relevant problems

Text books:

1. Electric Machines, I.J. Nagarath and D. P. Kothari, T.M.H 4th Edition,2010
2. Electric Machines, Mulukuntla S Sarma, Mukesh K. Pathak, Cengage Learning, First edition, 2009.

References

1. Performance and Design of A C Machines, M G Say, C S B Publishers, 3rdEdition, 2002
2. Theory of Alternating current Machines, Alexander Langsdorf, T M H 2nd edition, 2001
3. Electrical Machines and Transformers, Kosow, Pearson, 2nd edition, 2007

Sub Code:BTEE15F4500	**Microcontrollers and Applications**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To describe the architecture of microcontroller and various features associated with different models of the microcontrollers. 2. To discuss various computations and accessing methods associated with the microcontrollers. 3. To develop the skill of programming microcontrollers in controlling different applications in real time. 4. To demonstrate the interfacing of various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. To recognize the architecture of the 8051 and MSP430 microcontrollers. 2. To be adept at using various inbuilt features and external peripherals based on the requirement. 3. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller. 4. To develop the ability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

COURSE CONTENTS

UNIT-I Fundamentals of 8051 [11 hr]

Fundamentals of Microprocessor, Comparison of Microprocessor and Microcontroller, Harvard and Von Neuman architecture, RISC and CISC, block diagram of Microcontroller 8051 and functions of each block, pin details of 8051, Memory organization, External memory interfacing, stack, time delay calculations.

UNIT-II Features of 8051 [11 hr]

Instruction set of 8051 along with simple programs, addressing modes, programming in C, Timers/Counters and programming, Interrupts and programming.

UNIT – III Communication and Interfacing [11 hr]
I/O port programming, Serial communication.
Interfacing: ADC and DAC, LCD, DC motor, stepper motor, sensors (e.g.: temperature, pressure). Case studies/application notes.

UNIT-IV MSP 430 microcontroller [11 hr]
MSP430 RISC CPU architecture, instruction set, on-chip peripherals of MSP430, Programming in C, case studies/application notes.

Text books:
1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay ,"The 8051 Microcontroller and Embedded Systems – using assembly and C ", PHI, 2006 / Pearson, 2006
2. John Davies , "MSP430 Microcontroller Basics", Elsevier, 2010 (Indian edition available)

Reference Books:
1. Ajit pal , "Microcontrollers, Principles and Applications " PHI Ltd., - 2011.
2. Design reference notes and data sheets of MSP430 (TI).

Sub Code:BTEE15F4600	Power Electronics	C	L	T	P	CH
Duration: 14 Weeks		3	2	1	0	4
Course Objectives	1. To provide basic knowledge of power semiconductor devices. 2. To illustrate the students with the design concepts of Gate driver circuits, isolation and protection circuits of various power semiconductor devices. 3. To distinguish the Diode Rectifiers with Phase controlled Rectifiers for various loads. 4. To inculcate the skills of analyzing the basic topologies of DC-DC converters and AC voltage regulators for various loads. 5. To discuss the different modulation techniques of pulse width modulated inverters.					
Course Outcomes	After the completion of the course student will be able to: 1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT and power MOSFETs. 2. Develop circuit models using electronic components such as resistors, capacitors, diodes and transistors. 3. Design the power semiconductor devices drive circuitry and driver ICs and heat sinks. 4. Analyze and design electronic circuits such as control rectifiers, inverters, choppers &AC voltage regulators. 5. Describe the role of Power Electronics as an enabling technologyin various applications such as flexible production systems, energy					

	conservation, renewable energy, transportation etc.

COURSE CONTENTS

UNIT – I Power Semiconductor Devices [11 hr]

Introduction to Semiconductors, Power Electronics, Power semiconductor devices – control characteristics. Types of power electronic converters, Industrial applications.

Power Transistors: Power BJT's – switching Characteristics, switching limits, base drive control, Power MOSFETs & IGBT's characteristics, gate driver circuits, Isolation of gate and base drives.

UNIT – II Thyristors [11 hr]

Introduction, Two Transistor Model, Characteristics – Static & Dynamic, di/dt , dv/dt protection, Ratings & Types of thyristors, Series & Parallel operations of thyristors, Thyristors firingcircuits: Design using UJT, R, RC circuits.

Commutation Techniques: Definitions and conditions for commutation, Natural & Forced commutation, self-commutation, impulse commutation, resonant pulse commutation, Complementary commutation

UNIT – III [11 hr]

(a) Phase Controlled Converters

Introduction to 2-pulse, 3-pulse, 6-pulse converters, Principle of phase controlled converter operation, Single phase semi& full converters with R and RL load, Significance of freewheeling diode, Three phase half wave & full converter. (Only qualitative analysis)

(b) AC Voltage Controller

Introduction, Principle of ON-OFF & Phase Control, Single Phase bi-directional controllers with R & RL Loads.

UNIT – IV [11 hr]

(a) DC to DC Converters

(a) Introduction, Principle of step down & step up chopper with R and R-L load, Performance parameters, Time ratio control and current limit control, Chopper Classification.

(b) Inverters

Introduction, Principle of operation, Performance parameters, Single phase bridge inverters, three phase inverters (both 120^0 mode and 180^0 mode). PWM Techniques to control voltage of single phase inverters -- Single PWM, Multiple PWM & Sinusoidal PWM, Current Source inverters

Text books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices, and Applications", Prentice-Hall International third edition 2006.

2. M D Singh and Khanchandani K B , “Power Electronics”, TMH second edition 2001.

Reference Books:

1. Mohan / Undeland / Robbins , “Power Electronics: Converters, Applications, and Design”, Wiley third edition 2008.
2. John G. Kassakian, Addison Wesley , “Principles of Power electronics”.

Sub Code:BTEE15F4700	**Microcontroller Laboratory**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**2**	**1**	**0**	**1**	**3**
Course Objectives	1. Understand the architecture of microcontroller and various features associated with the different models of the microcontrollers. 2. Understanding of various computations and accessing methods associated with the microcontrollers. 3. Gain the knowledge of programming. 4. Develop the ability to program the microcontroller in controlling the different applications in real time. 5. Develop the capability to program and interface various devices to the microcontroller.					
Course Outcomes	After the completion of the course the student will be able to: 1. Learn the architecture of the 8051, PIC and MSP430 microcontrollers. 2. Become adept at using various inbuilt features and external peripherals based on the requirement. 3. Design simple electronic circuits which could be controlledusing the microcontroller. 4. Develop the capability to program any microcontroller knowing the features of the chosen IC and to interface external devices to the microcontroller.					

List of Experiments:

1. Data Transfer, Data Exchange, Bubble Sort,
2. Arithmetic & Logic operations – addition, subtraction, multiplication(16 bit), division(8 bit), 2 out of 5 code.
3. Bit manipulation – Boolean expression implementation
4. Code conversions – ASCII to BCD, BCD to ASCII, Hex to Decimal, Decimal to Hex
5. DAC & ADC interfacing with 8051
6. Keypad & LCD interfacing with 8051
7. Stepper & DC motor interfacing with 8051

Sub Code:BTEE15F4800	Power Electronics Laboratory	C	L	T	P	CH
Duration: 14 Weeks		2	1	0	1	3
Course Objectives	1. To get an overview of different types of power semi-conductor devices and their switching characteristics. 2. To understand the operation, characteristics and performance parameters of controlled rectifiers. 3. To study the operation, switching techniques and basic topologies of DC-DC switching regulators. 4. To learn the different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.					
Course Outcomes	After the completion of the course the student will be able to: 1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT and power MOSFETs. 2. Develop circuit models using electronic components such as resistors, capacitors, diodes and transistors. 3. Analyze and design electronic circuits such as control rectifiers, inverters, choppers & ac voltage regulators. 4. Describe the role of Power Electronics as an enabling technology in various applications.					

List of Experiments:

1. Static characteristics of SCR
2. Static characteristics of MOSFET and IGBT
3. SCR turn on circuit using synchronized UJT relaxation oscillator.
4. SCR Digital triggering circuit for a single phase controlled rectifier and AC voltage regulator
5. Single phase controlled full wave rectifier with R and RL loads
6. AC voltage controller using TRIAC and DIAC combination connected to R and RL loads
7. Speed control of a separately excited DC motor using and IGBT or MOSFET chopper
8. Speed control of DC motor using single semi converter
9. Speed control of a stepper motor
10. Speed control of universal motor using AC voltage controller
11. MOSFET or IGBT based single phase full bridge inverter connected to R load
12. Study of commutation using LC circuits and auxiliary circuits

V Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F5100	Control Engineering	HC	3	2	1	0	4
2	BTEE15F5200	Transmission and Distribution	HC	4	3	1	0	5
3	BTEE15F5300	Signals and Systems	HC	3	2	1	0	4
4	BTEE15F5400	Electrical Machines II	HC	3	2	1	0	4
5	BTEE15F5501	Electrical Power Utilization	SC	4	3	1	0	5
	BTEE15F5502	Electrical Drives						
	BTEE15F5503	Digital system design using VHDL						
	BTEE15F5504	Computer Networks Concepts and Protocols						
6	BTEE15F5601	Design of Electrical Machines	SC	4	3	1	0	5
	BTEE15F5602	Advanced Power Electronics						
	BTEE15F5603	Programmable Logic Controllers						
	BTEE15F5604	Programming in Java						
7	BTEE15F5700	Electrical Machines Laboratory I	HC	2	1	0	1	3
8	BTEE15F5800	Electrical and Electronics Measurements Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**25**	**17**	**6**	**2**	**33**

Sub Code:BTEE15F5100	**Control Engineering**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To understand the methods of representation of systems and to desire their transfer function models reduction of block diagrams. 2. To provide adequate knowledge in the time response of systems and steady state error analysis, different types of controller. 3. To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems & to understand the concept of stability of control system and methods of stability analysis. 4. To study the three ways of designing compensation for a control system and state space analysis					
Course Outcomes	On completion of this course the students will be able to: 1. Identity the applications of close loop and open loop systems and time variant and invariant systems. 2. Describe the controller application and time domain analysis. 3. Differentiate between time and frequency analysis and to determine stability by using different methods. 4. Analyze the system stable and unstable conditions and to design the compensation networks by identifying the error in the system					

COURSE CONTENTS

Unit 1: Modeling of control system and their representations **[10hrs]**

Basic elements in control systems – classification of systems, Open and closed loop systems – Electrical analogy of mechanical systems –Syn chros – types of servomotors

Block diagram: Block diagram representation, reduction techniques – Signal flow graphs.

Unit 2: Time response and controller characteristics **[11hrs]**

Time response – Time domain specifications – Types of test input – I and II order system response –Effect of adding zero to second order system steady state Error & coefficients

Controllers: Classification of controllers-P, PI, PID modes of feedback control, effect of integral and derivative control on the system performance.

Unit 3: Frequency response and stability analysis **[11Hrs]**

Frequency response – -advantages of frequency domain analysis- Bode plot, Relative and absolute stability, Frequency response of closed loop system.

Stability analysis: Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin.

Unit 4: State space analysis of control system & compensation techniques **[10Hrs]**

State space representation electrical mechanical systems, transfer matrix, computation of state transition matrix, controllability and observability

Compensation techniques: Types of compensation, design of compensation using bode plot

Text books:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. Syed hasan saeed, 'Automatic control systems', publishers of engineering and computer books, new Delhi, 6th edition,2012.
3. Benjamin C. Kuo, 'Automatic Control systems', Pearson Education, New Delhi, 2003.

Reference Books:

1. K. Ogata, ‘Modern Control Engineering’, 4th edition, PHI, New Delhi, 2002.
2. Norman S. Nise, ‘Control Systems Engineering’, 4th Edition, John Wiley, New Delhi, 2007.
3. Samarajit Ghosh, ‘Control systems’, Pearson Education, New Delhi, 2004
4. M. Gopal, ‘Control Systems, Principles and Design’, Tata McGraw Hill, New Delhi, 2002.

Sub Code: BTEE15F5200	**Transmission and Distribution**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. Provide detailed information about the need of power transmission & distribution and the components involved in the process. 2. Provide information of conductors & insulators which will be used for the transmission. 3. Provide information about the losses that occur during transmission and the ways of reducing the same. 4. Explain the line parameters & constants associated with transmission lines & calculation of the same and to provide the information regarding power distribution, types of distribution systems & the terms relating to distribution					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the general layout of transmission and distribution of electrical system along with equipment. 2. Calculate and select the appropriate size of conductors and insulators for transmission & distribution system. 3. Compute the transmission and distribution losses and understand the various ways of reducing these losses. 4. Understand the different types of transmission and distribution systems with their merits and de-merits. 5. Identify the application of underground cables for various applications					

COURSE CONTENTS

Unit 1: **[12hrs]**

Typical Transmission & Distribution System:

Introduction, general layout of power system scheme, Standard voltages for transmission, advantages of high voltage transmission, Transmission line efficiency & line drop, Feeders, Distributors & Service mains.

Overhead Transmission Lines:

Types of supporting structures & line conductors used**,** Sag calculation- Supports at same level, Supports at different levels, Effect of wind & ice on sag calculation, Stringing chart, Sagtemplate & Vibrators, Problems on sag calculation.

Unit 2: [9hrs]

Insulators:

Introduction, Materials used, Types**,** Potential Distribution over suspension insulators, String efficiency, Methods to improve string efficiency, Grading rings, Arching horns, Testing of Insulators, Problems.

Corona:

Introduction, Phenomenon of corona, Disruptive & Critical voltages, Power loss due corona, Advantages & Disadvantages of corona, Problems

Unit 3: [15hrs]

Line Parameters:

Introduction, Calculation of inductance of single phase line, 3phase lines with equilateral spacing, Unsymmetrical Spacing, transposed lines, Inductance of composite conductor lines, Capacitance of single phase line, 3 phase lines with equilateral spacing, 3 phase lines with unsymmetrical spacing, Problems.

Performance of transmission lines:

Introduction, Short transmission lines, Medium transmission lines- Nominal T & Π method, End condenser method, Long transmission lines, ABCD constants of transmission lines, Ferranti Effect, Line regulation, Problems.

Unit 4: [6hrs]

Distribution:

Introduction, Requirements of power distribution, Radial & ring main systems, AC Distribution, Calculation for concentrated loads & uniform loading

Underground Cables:

Introduction, types, materials used for underground cables, Insulation resistance, thermal rating of cables, Charging current, Grading of cables, Capacitance grading & Intersheath grading, Testing of cables

Text Books:

1. Soni Gupta & Bhatanagar, "A Course of Electrical Power", DhanpatRai& Sons (New Delhi)
2. C. L. Wadhwa "Electrical Power Systems", Wiley Eastern.

Reference Books:

1. W D Stevenson, 'Elements of Power System Analysis', TMH,4^{th} edition
2. S M Singh, 'Electric Power Generation Transmission & Distribution, PHI, 2^{nd} Edition, 2009
3. Dr S L Uppal, 'Electrical Power', Khanna Publications

Sub Code: BTEE15F5300	**Signals and Systems**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. Understanding the fundamental characteristics of signals and systems. 2. Understanding signals and systems in terms of both the time/space and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide 3. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling. 4. Make basic use of professional tools such as Matlab for signal and system analysis					
Course Outcomes	After the completion of the course the student will be able to: 1. Understand general signals and system properties and linear and time-invariant systems 2. Understand convolution sum and integral 3. Understand time and frequency domain representation of linear signals and systems 4. Perform Discrete-time (DT) and Continuous-time (CT) Fourier Transforms 5. Understand Fourier Transform Properties Filtering of CT and DT signals					

COURSE CONTENTS

Unit 1: Introduction **[12hrs]**

Definitions of signals and a system, classification of signals, basic operations on signals, elementary signals viewed as interconnections of operations, properties of systems.

Unit 2 : Time Domain Representations for LTI Systems **[10hrs]**

Convolution, impulse response, properties, solution of differential and difference equations,block diagram representation.

Unit 3: Fourier Series and Fourier Transform Representation **[10hrs]**

Introduction, Fourier representation of continuous-time periodic signals (FS), properties of continuous-time Fourier series. Fourier transform representation of a continuous-time Fourier transforms (FT), the discrete time Fourier transform (DTFT)

Unit 4: Z- Transforms **[10hrs]**

Introduction, Z-transform, properties of ROC, properties of Z-transforms, inversion of Z-transform methods - power series and partial expansion, Transforms analysis of LTI systems, transfer function, stability and causality, unilateral Z-transform and its application to solve difference equations.

Text Books:

1. Simon Haykin and Barry Van Veen, 'Signals and Systems', John Wiley & Sons, 2nd edition, 2008
2. Michel J Roberts, 'Fundamentals of Signals and Systems ', TMH, 2nd Edition, 2010.
3. P.Ramesh Babu, 'Signals and systems ', Scitech Publications , 4th Edition, 2011.

Reference Books:

1. Alan V Oppenheim, Alan S. Willsky and S. Hamid Nawab, 'Signals and Systems', PHI, 2nd edition, 2009.
2. H P Hsu and others, 'Signals and Systems' , Schaums Outline Series, TMH, 2nd Edition, 2008

Sub Code:BTEE15F5400	**Electrical Machines –II**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**3**	**2**	**1**	**0**	**4**
Course Objectives	1. To gain knowledge about the principle of converting electrical energy to mechanical energy and vice-versa through electromagnetic field 2. To have good understanding of physical concepts and					

	operational features of DC and synchronous machines. 3. To equip the students with basic experimental skills for handling problems associated with electrical machines 4. To provide basis for further study of electrical machines
Course Outcomes	On completion of this course the students will be able to: 1. Reveal their knowledge and understanding of electromechanical energy conversion in DC and synchronous machines 2. Analyze the concepts of fundamental torque equation and rotating fields 3. Analyze the fundamental characteristics of DC and synchronous machines 4. Interpret experimental results and correlate them with theoretical predictions

COURSE CONTENTS

Unit 1: Principles of Electro-Mechanical Energy Conversion and DC Generators **[12hrs]**

Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy) , Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation , Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque , torque in machines with cylindrical air gap . Construction of DC Machines, Armature winding, Emf and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Performance Characteristics of D.C. generators,

Unit 2 : D.C. Motors **[12hrs]**

PrincipleMand Construction, Significance of Emf and torque equation, Performance Characteristics of D.C. motors, Starting of D.C. motors; 3 point and 4 point starters , Speed control of D.C. motors: Field Control, armature control and Voltage Control (Ward Lenonard method); Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test).

Unit-3 : Synchronous Machine I **[12hrs]**

Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient

Unit 4 : Synchronous Machine II **[12hrs]**

Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics Synchronous Motor, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser, reluctance motor

Text Books:

1. I.J. Nagrath & D.P.Kothari, 'Electrical Machines', Tata McGraw Hill
2. Husain Ashfaq , 'Electrical Machines', Dhanpat Rai & Sons
3. A.E. Fitggerald, C.Kingsley Jr and Umans, 'Electric Machinery' 6th Edition McGraw Hill, International Student Edition.
4. P.S.Bimbhra, 'Electrical Machinery', Khanna Publisher

Reference Books:

1. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', Khanna Publishers
2. M.G. Say, 'Alternating Current Machines', Pitman & Sons
3. B.R. Gupta & Vandana Singhal, 'Fundamentals of Electrical Machines', New Age International.
4. Irving L. Kosow, 'Electric Machine and Transformers', Prentice Hall of India

Sub Code: BTEE15F5501	**Electrical Power Utilization**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To enable students to understand the advantages of utilization of electricity. 2. To give an insight into various industrial applications of electricity					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to think innovatively for other ways of producing electricity. 2. Be able to propose efficient methods to the industries with the usage of electricity					

COURSE CONTENTS

Unit 1: Electric Traction **[12hrs]**

Introduction, requirements of an ideal traction, systems of traction, speed time curve, tractive effort, co-efficient of adhesion, selection of traction motors, method of speed control, energy saving by series parallel control, ac traction equipment. AC series motor, characteristics, regenerative braking, linear induction motor and their use. AC traction, specific energy, factors affecting specific energy consumption.

Unit 2: **[12hrs]**

Introduction to Electric and Hybrid Vehicles: Configuration and performance of electrical vehicles, traction motor characteristics, tractive effort, transmission requirement, vehicle performance and energy consumption.

Electrolytic Process: Fundamental principles, extraction, refining of metals and electroplating. Factors affecting electro deposition process, power supply for electrolytic process.

Illumination: Laws of illumination, lighting calculation, factory lighting, flood lighting, street lighting, different types of lamps-incandescent, fluorescent, vapor, CFL and LED lamps and their working, comparison, Glare and its remedy.

Unit 4: Heating and Welding **[12hrs]**

Advantages and methods of electric of heating, resistance ovens, induction heating, dielectric heating, the arc furnace, heating of building. Electric welding, resistance and arc welding, control devices and welding equipment.

Text Books :

1. E Openshaw Taylor, 'Utilization Of Electric Energy', 12^{th} Impression, 2009, Universities Press.
2. Mehrdad, Ehsani, Yimin Gao, Sabastien. E. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles', CRC Press.

Reference Books:

1. Soni Gupta and Bhatnager, 'A Course in Electrical Power', Dhanapat Rai & Sons.
2. Dr. S.L.Uppal, 'Electrical Power', Khanna Publications

Sub Code: BTEE15F5502	**Electrical Drives**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the basics of electrical drive system 2. To Develop mathematical models of a drive (DC) system. 3. To understand the control aspects of electrical drives					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the structure of a drive system and their role in any application. 2. Develop mathematical models using transfer functions for a DC motor 3. Analyze the given specifications and suggest a suitable motor for a particular application (like elevator system, escalator system, electric vehicle) 4. Select a power electronic converter and decide its operational parameters for DC & AC motor drive system					

COURSE CONTENTS

Unit 1: Basic Elements of Electrical Drives **[14hrs]**

Components of electrical Drives – electric machines, power converter, controllers - dynamics of electric drive - torque equation - equivalent values of drive parameters- components of load torques types of load - four quadrant operation of a motor — steady state stability – load equalization – classes of motor duty- determination of motor rating.

Unit 2: DC Motor Drives **[10hrs]**

Starting methods, Braking- Regenerative, Dynamic, Plugging related problems, method of armature voltage control, ward Leonard drives

Unit 3: Speed Control of DC Drives **[16hrs]**

Different types of controlled rectifier circuits and their operation- controlled rectifier fed dc drives, 1-ph fully controlled rectifier control of dc separately excited motor, 3-ph fully controlledrectifier control of dc separately excited motor, chopper control of separately excited motor, supply harmonics, power factor, and ripple in motor current, simulation of chopper controlled DC drive in SIMULINK

Unit 4: Induction Motor Drives **[16hrs]**

Speed-Torque characteristics. For braking- regenerative, dynamic, plugging soft start, stator voltage control, performance of induction motor under unbalanced supply and single phasing, variable frequency control, slip speed control. Induction motor slip power recovery drives, Static Kramer drive

Text Books:

1. G.K.Dubey, 'Power semiconductor controlled drives', Prentice Hall, 1989
2. P.C.Sen, 'Principles of Electric Machines and Power Electronics', John Wiley & Sons, 2nd Edition, 1996.

References:

1. P.C.Sen, 'Principles of Electric Machines and Power Electronics', John Wiley & Sons, 2nd Edition, 1996.
2. Vedam Subrahmaniam, 'Electric Drives', TMH, 1994
3. R. Krishnan, 'Electrical Motor Drives', PHI, 2003
4. Bimal. K.Bose, 'Modern Power Electronics and AC Drives', Pearson Education
5. Introduction to Electrical Drives: http://textofvideo.nptel.iitm.ac.in/video.php?courseId=108108077

Sub Code: BTEE15F5503	**Digital System Design Using VHDL**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To demonstrate an understanding of the fundamentals for an HDL. 2. To demonstrate an understanding of data flow descriptions. 3. To implement combinational and sequential circuits using					

	VHDL. 4. To implement various digital circuits using Programmable Logic Devices. 5. Design of State Machines
Course Outcomes	On completion of this course the students will be able to: 1. Compare Verilog HDL and VHDL. 2. Design simple logic circuits using data flow, structural and behavioral modelling concepts. 3. Implement combinational and sequential circuits. 4. Realize State Machine Charts for various applications

COURSE CONTENTS

Unit 1: **[12hrs]**

Introduction: A Brief History of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Comparison of VHDL and Verilog.

Data –Flow Descriptions: Data-Flow Description, Structure of Data-Flow Description, Data Type – Vectors.

Unit 2: **[12hrs]**

Behavioral Modelling: Behavioral Description, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements.

Structural Modelling: Structural Description, Organization of the structural Descriptions, Binding, state Machines, Generate, Generic, and Parameter statements.

Unit 3: **[12hrs]**

Combinational and Sequential Circuit Design: VHDL Models and Simulation of combinational circuits-Multiplexers, Demultiplexers, encoders, decoders , code converters, comparators, implementation of Boolean functions. VHDL Models and Simulation of SequentialCircuits Shift Registers, Counters

Unit 4: **[12hrs]**

Designing with programmable logic devices: Read-only memories, Programmable logic arrays (PLAs), Programmable array logic (PALs), Other sequential programmable logic devices (PLDs).

Digital Design With SM Charts: State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines.

Text Books :

1. Charles H. Roth. Jr, 'Digital Systems Design Using VHDL', Cengage, 2010.
2. A Pedroni, Volnet, 'Digital Electronics and Design With VHDL', Elsevier, 1st edition, 2008
3. Brown and Vranesic, 'Fundamentals of Digital Logic with VHDL Design', McGraw Hill, 3rd Edition 2008.

Reference Books:

1. Stephen Brwon & Zvonko Vranesic, 'Fundamentals of Digital Logic with VHDL Design', TMH, 2nd Edition 2006
2. Floyd, 'Digital Fundamentals using VHDL', Pearson Education, 2003
3. Wakerly J. F., 'Digital Design – Principles and Practices', 4th Edition, Pearson Education,2008.
4. Navabi, 'Vhdl Modular Design', McGraw Hill, 2008

Sub Code: BTEE15F5504	**Computer Networks Concepts and Protocols**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. Describe the concept of Protocol Stacks (OSI and TCP/IP), data communication with packet switching and virtual circuit networks. 2. Give knowledge about network topologies and Ethernet standards 3. Explain various media access techniques, error detection and correction mechanisms 4. Familiarize the students with routing and error reporting protocols 5. Gain expertise in transport layer and application layer standards and protocols					
Course Outcomes	On completion of this course the students will be able to: 1. Use protocol stacks (OSI and TCP/IP) for developing data communication applications 2. Apply error detection & correction strategies for data transmission 3. Establish network of computing devices using topology and Ethernet standards 4. Experiment routing protocols and error reporting protocols 5. Design and develop communication applications using TCP/UDP standards					

COURSE CONTENTS

Unit 1: **[10hrs]**

Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Protocols & Standards, Layered Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing. Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks. (Ch.1.1, 1.2, 1.3, 1.4, 21, 2.2, 2.3, 2.4, 2.5, 8.1, 8.2, 8.3)

Unit 2: **[10hrs]**

Concepts of Multiplexing, FDM, WDM, TDM, Line coding methods, Digital Modulation techniques, **Networking Devices:** Digital Subscriber Line Modems, Cable Modems, Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways.

Error Detection and Correction: Introduction, cyclic Codes: Cyclic redundancy code generation for checksum. Frames, Packets, Point-to-Point Protocol, CSMA/CD, CSMA/CA, Controlled Access: Reservation, Polling, Token passing.

Unit 3: **[10hrs]**

Network Topologies, Classification of Networks, Protocols, PPP, IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Architecture, MAC Sublayer,Addressing Mechanism. IPv4 addresses, IPv6 addresses, transition from IPv4 to IPv6.

Unit 4: **[10hrs]**

Standards and Protocols: User Datagram Protocol (UDP): UDP Segment, Transmission Control Protocol (TCP): TCP Segment, Connection Set up, Application of TCP and UDP. TCP Congestion Control.

Domain Name System (DNS): Name/Address Mapping, DNS Message Format. Remote Login Protocols: TELNET Protocol and SSH Protocol. Electronic Mail (E-Mail), World Wide Web (WWW).

Basic concepts of FTP, GSM, LTE, MPLS, VPN, ATM, Bluetooth. WiFi, WiMax.

Text Books:

1. Behrouz A Forouzan, ‘Data Communications and Networking’, 4th Edition, McGraw – Hill, 2006
2. Nader F. Mir, ‘Computer and Communication Networks’, Pearson Education, 2009

<table>
<tr><td>Sub Code:
BTEE15F5601</td><td rowspan="2">Design of Electrical Machines</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable students to understand the application of basic electro-magnetic laws.
2. To give an insight into constructional details of internal parts of the machines</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Be able to apply basic electro-magnetic laws to mould the laboratory modules.
2. Be able to select efficient materials for the best performance of the machine</td></tr>
</table>

COURSE CONTENTS

Unit 1: **[14hrs]**

Basics of Electrical Machine Design:
Introduction, considerations for the design of electrical machines, limitations. Different types of materials and insulators used in electrical machines.

DC Generator and DC Motor Design:
Output equation, choice of specific loadings and choice of number of poles, design of Main dimensions of the DC machines, Design of armature slot dimensions, commutators and brushes, magnetic circuit - estimation of ampere turns, design of yoke and poles- main and inter poles, field windings – shunt, series and inter poles.

Unit 2: Single Phase and Three Phase Transformers Design **[14hrs]**

Output equation for single phase and three phase transformers, choice of specific loadings, expression for volts/turn, determination of main dimensions of the core, types of windings and estimation of number of turns and conductor cross sectional area of Primary and secondary windings, estimation of no load current, expression for leakage reactance and voltage regulation. Design of tank and cooling tubes (round and rectangular)

Unit 3: Three Phase Induction Motor Design **[14hrs]**

Output equation, Choice of specific loadings, main dimensions of three phase induction motor, Stator winding design, choice of length of the air gap, estimation of number of slots for the squirrel cage rotor, design of rotor bars and end ring, design of slip ring induction motor, estimation of no load current and leakage reactance, and circle diagram.

Unit 4: Synchronous Machines **[14hrs]**

Output equation, Choice of specific loadings, short circuit ratio, design of main dimensions, armature slots and windings, slot details for the stator of salient and non salient pole synchronous machines. Design of rotor of salient pole synchronous machines, magnetic circuits, dimensions of the pole body, design of the field winding, and design of rotor of non-salient pole machine.

Text Books:

1. A.K.Sawhney, 'A Course In Electrical Machine Design', Dhanpatt Rai & Sons
2. V. N. Mittle, 'Design Of Electrical Machines', 4th edition

Reference Books:

1. M.G.Say, 'Performance And Design Of AC Machines', CBS Publishers and Distributors Pvt.Ltd.
2. R.K.Aggarwal, 'Principles of Electrical Machine Design'.
3. Shanmugasundarm, G,Gangadharan,R.Palani, 'Design Data Handbook', AWiley Eastern Ltd.

Sub Code: BTEE15F5602	**Advanced Power Electronics**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To develop analytical techniques for isolated/non-isolated converters in steady state. 2. To design and simulate a basic dc-dc power supply for given specifications. 3. To describe the operation and pulse width modulation strategies in inverters. 4. 4. To familiarize with various element of a practical power converter circuitry					
Course Outcomes	On completion of this course the students will be able to: 1. Analyze any arbitrary dc-dc converter in steady state. 2. Design the output filter components to meet the required specifications. 3. Choose the appropriate switching device based on circuit operation. 4. Identify the various blocks in a practical PWM control circuitry. 5. Apply knowledge of converters for practical applications in electrical industry					

COURSE CONTENTS

Unit 1: Switched Mode Power Conversion: DC-DC Converters [14hrs]

Introduction to power processing, Linear Regulator Vs Switching Regulator. Basics of steady state analysis- Inductor Volt-second, capacitor charge balance, small ripple approximation.

Principle of operation of buck, boost, buck-boost, Design of output filters components, selection of switch ratings. -Numerical problems

Discontinuous conduction Mode Operation: Buck and Boost converters.

Analysis using software tools: Simulation of DC-DC converters using MATLAB/LTSpice.

Unit 2: DC Power supplies **[14hrs]**

Switch Realization: Single-,two-, and four-quadrant switches, Selection of power semiconductor switch based on application. DC power supplies: fly back converter, forward converter, push- pull converter, half bridge converter, full bridge converter

Review of Fourier series, fundamental and harmonic voltages. Harmonics generated by SMPS power supplies, undesirable effect on power systems, power factor.

Analysis using software tools: Simulation of DC power supplies using MATLAB/LTSpice

Unit 3: Inverters and Pulse width modulation (PWM) Techniques **[14hrs]**

Effects of harmonic voltages. Inverters- Control of fundamental voltage, harmonic mitigation

PWM Inverters: Square wave operation, Voltage control of single phase inverters - sinusoidal PWM and its Realization, Other Popular PWM Techniques, harmonic analysis -Numerical problems. Current Source Inverter, Load-commutated Current Source Inverter (CSI)

Unit 4: Practical Aspects of Converters **[14hrs]**

IC based linear regulators: LM78xx series. Basics elements of PWM Control: PWM control IC and its components, Need for Driver circuit, isolation techniques. Application of DC-DC converters-Power factor correction, solar power application. Applications of inverters- Design of UPS, Grid tied PV system.

Text Books:

1. Daniel Hart, ‘Power Electronics’, Tata McGraw Hill, 2011
2. Ned Mohan Tore. M. Undeland and William. P. Robbins, ‘Power Electronics: Converters, Applications and Design’, John Wiley and Sons, 2011
3. Rashid M.H., ‘Power Electronics – Circuits Devices and Applications’, 3rd Edition, Pearson, 2011.
4. L. Umanand, ‘Power Electronics: Essentials and Applications’, Wiley India Pvt. Ltd.

Reference Books:

1. Robert W. Erickson and Dragon Maksimovic, 'Fundamentals of Power Electronics', Springer International edition.
2. D.M. Mitchell, 'DC-DC Switching Regulator Analysis', McGraw Hill

Sub Code: BTEE15F5603	**Programmable Logic Controllers**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To provide knowledge levels of PLC programming 2. To train the students for creating ladder logic for PLC processes programming. 3. To apply the knowledge of Timers and Counters for Industrial applications					
Course Outcomes	On completion of this course the students will be able to: 1. Ability to gain knowledge on Programmable Logic Controllers. 2. To provide the knowledge about various types of registers in PLC. 3. Able to create the ladder diagrams from process and control descriptions					

COURSE CONTENTS

Unit 1: **[10hrs]**

PLC Basics: PLC system, Internal architecture I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules.

Unit 2: **[10hrs]**

PLC Programming: Input Devices: Mechanical switches, Proximity switches, Photoelectric sensors and switches; Temperature sensors, position / Displacement sensors; Strain gauge sensors; Pressure sensors; Liquid level detectors; Fluid flow measurement ; Smart sensors;Outputs Devices : Relay; Directional control valves; Motors ; Stepper motors; Operational procedures, programming examples and PLC applications.

Unit 3: **[10hrs]**

Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

Unit 4: [10hrs]

PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

PLC Functions: Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions

Analog PLC operation: Analog modules& systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions.

Text Books:

1. John W. Webb & Ronald A. Reiss, ‘Programmable Logic Controllers- Principles and Applications’, Fifth Edition, PHI
2. J R.Hackworth &F.D Hackworth Jr., ‘Pogrammable Logic Controllers- Programming Method and Applications’, Pearson, 2004
3. William Bolton, ‘Programmable Logic Controllers’, fifth Edition.

<table>
<tr><td>Sub Code: BTEE15F5604</td><td rowspan="2">Programming in Java</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications)
2. Illustrate the usage of a Java-enabled browser and/or the applet viewer to execute Java applets along with Java Application Programming Interface and Java multi-class programs
3. Design, implement, test, and debug Java applications written using basic concepts such as primitive data types, various operators, control structures, single-subscripted arrays, and Java classes
4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Analyze the principles and concepts of object-oriented programming;
2. Use a Java-enabled browser and/or the appletviewer to execute Java applets
3. Use the Java interpreter to run Java applications
4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design.</td></tr>
</table>

	5. Describe, modify and debug Java programs using primitive data types, various operators, control structures, single-subscripted arrays, multi-class and object-based programming techniques including classes, objects and inheritance

COURSE CONTENTS

Unit 1: **[12hrs]**

Primitive Data Types and Arithmetic: Data, Data Storage, Identifiers, Syntax, Variables and Constants, the Format of a Simple Program, Arithmetic, Operator Precedence, Casting,

Objects: Introduction to Objects, The String Class, The Anatomy of a Simple Program Revisited, The AVI Package, The Window Class, Input to a Dialog Box, Converting Strings to Numbers, Command Line Arguments, Errors

Unit 2: **[12hrs]**

Object-Oriented Programming: Abstract Data Type, Constructors, Instance Methods, Class Methods, Scope and Lifetime of Identifiers, Software Development, Object-Oriented Program Design, the AVI Package Revisited

Selection: More AVI Classes, If..else Statement, Nested If Statement, Conditional Expressions, Else if Statements, Boolean Data Type, Switch, Wrapper Classes, Yet another AVI Class!, The This Object.

Unit 3: **[12hrs]**

Repetition and One-Dimensional Arrays: Loop Structure, While Loop, Do..while Loop, Increment/Decrement Operators, For Loop, Which Loop?, Arrays Revisited, Declaring and Initializing One-Dimensional Arrays, Using Arrays, Our Last AVI Class: CheckBoxes, Formatting Numbers for Output

Advanced Concepts with Classes: Inheritance, An Example of Inheritance, Overriding Superclass Methods, Polymorphism, Instanceof Operator, Shadowed Variables, Inner Classes, Abstract Methods and Classes, Interfaces, Constructors Revisited, Instance Methods Revisited, Object Properties, Comparing Objects, Copying Objects, Passing Objects as Parameters, Garbage Collection and Object Finalization

Unit 4: **[12hrs]**

Exceptions and Streams: Introduction, Exception Classes, Catching an Exception, Catching Multiple Exceptions, Creating Your Own Exception Class, Throwing an Exception, FinallyBlocks, Using Exception Handling, Stream Input and Output, The Stream Tokenizer Class, Text File Processing, The File Dialog,

Applets and Threads: Introduction, Applets, Input to Applets, Playing Sounds, Displaying Images, Loading Images, Arrays Revisited, Image Maps, Threads, Animation, Restrictions,Sound and Images with Applications

Text Books:

1. Barry J. Holmes and Daniel T. Joyce, 'Object-Oriented Programming With Java', second Edition, Jones and Bartlett Publishers,2000
2. Dale Skrien, 'Object-Oriented Design Using Java', McGraw-Hill Higher Education, 2009
3. Danny Poo, 'Object-Oriented Programming and Java', Second Edition, Springer, 2008

References:
1. Cay Horstmann, 'Big Java',2^{nd} Edition, John Wiley and Sons
2. Herbert Schildt, 'The Complete Reference Java J2SE', 5^{th} Edition, TMH Publishing Company Ltd, New Delhi
3. H.M.Dietel and P.J.Dietel, 'Java: How to Program', Sixth Edition, Pearson Education/PHI
4. Cay. S. Horstmann and Gary Cornell, 'Core Java 2, Vol 1, Fundamentals', Seventh Edition, Pearson Education/PHI
5. Iver Horton, 'Beginning in Java 2', Wrox Publications

<table>
<tr><td>Sub Code: BTEE15F5700</td><td rowspan="2">Electrical Machines Laboratory - I</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration :14 Wks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course Objectives:</td><td colspan="6">1. Learn different types of electromechanical energy conversion devices and their operating principles.
2. Judge the performance of a given machine through testing.
3. Comprehend the construction and speed control techniques for different types of D.C machines.
4. Evaluate the various characteristics of ac machines for industrial applications.</td></tr>
<tr><td>Course outcomes</td><td colspan="6">At the end of this course, Student will be able to
1. Apply the three phase transformer in the industrial needs like electrical drives and agricultural pumps etc.
2. Understand parallel operation of transformer, three phase transformer, auto transformer and their practical applications.
3. Analyze equivalent circuits of three phase transformers.
4. Understand the different testing methods for evaluating the various losses of the transformers</td></tr>
</table>

List of lab experiments:

1. (a) Predetermination of efficiency and regulation by Open Circuit and Short circuit tests on single - phase transformer.

   (b) Calculation of parameters of equivalent circuit from the readings of the tests and determination of efficiency and regulation from the equivalent circuit to correlate results obtained earlier.

2. Sumpner's test on similar transformers and determination of combined and individual transformer efficiency.
3. Parallel operation of two dissimilar (different kVA) single-phase transformers and determination of load sharing and analytical verification given the Open Circuit and Short circuit tests details.
4. Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.
5. Scott connection with balanced and unbalanced resistive loads.
6. Load test on 3-phase induction motor- and plot of Torque versus speed, output hp versus efficiency, power factor and slip.
7. Predetermination of performance of 3-phase induction Motor from the Circle diagram.
8. (a) Determination of parameters of the equivalent circuit of a 3-phase Induction Motor by conducting NO load and Blocked rotor tests.
   (b) Determination of performance quantities of the induction motor from the equivalent circuit to correlate the results obtained from the load test or circle diagram.
9. Speed control of 3-phase induction motor by varying rotor resistance.
10. Load test on single- phase induction motor

<table>
<tr><td>Sub Code: BTEE15F5800</td><td rowspan="2">Electrical and Electronics Measurement Laboratory</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration :14 Weeks</td><td>2</td><td>1</td><td>0</td><td>1</td><td>3</td></tr>
<tr><td>Course objectives</td><td colspan="6">1. To understand the working of various electrical bridge
2. To understand the energy meter
3. To know the working of Op-amps</td></tr>
<tr><td>Course outcomes</td><td colspan="6">At the end of this course, Student will be able to
1. Measure various parameters of given bridge
2. To apply the Op-amps in various signal processing circuits</td></tr>
</table>

List of lab experiments:

1. Measurements of low resistance using Kelvin’s Double Bridge.
2. Measurements of inductance using Maxwell inductance Capacitance bridge & determination of Q factor.
3. Measurements of capacitance using De-sauty’s bridge & determination of dissipation factor.
4. Measurement of active and reactive power in balanced 3 phase circuit using two watt meter method.
5. Adjustment & Calibration of single phase energy meter.
6. Inverting, non-inverting & scale charging of signals using Op amps (using simulation Packages)
7. RC phase shifting oscillator using op amps(using simulation Packages)
8. RC coupled amplifier – frequency response for variation of bias & coupling using simulation packages.
9. Rectifier circuits – Bridge rectifier, diode clipping & clamping circuits using simulation package.
10. Schmitt – Trigger inverting and non-inverting

VI Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F6100	Power System Analysis	HC	4	3	1	0	5
2	BTEE15F6200	High Voltage Engineering	HC	4	3	0	1	5
3	BTEE15F6300	Theory and Applications of Linear Integrated Circuits	HC	3	2	1	0	4
4	BTEE15F6401	Advanced Control Engineering	SC	3	2	1	0	4
	BTEE15F6402	Digital Relays						
	BTEE15F6403	Embedded systems and IOT						
	BTEE15F6404	DBMS						
5	BTEE15F6501	Power System Planning and Reliability	SC	3	2	1	0	4
	BTEE15F6502	Modeling and Simulation of Electrical Machines						
	BTEE15F6503	Operation Research						
	BTEE15F6504	Web Programming						
6	BTEE15F6601	Smart grid	SC	4	3	1	0	5
	BTEE15F6602	Digital Signal Processing						
	BTEE15F6603	VLSI Circuits and Design						
	BTEE15F6604	Data Structures using C++						
7	BTEE15F6700	Electrical Machines Laboratory II	HC	2	1	0	1	3
8	BTEE15F6800	Control System Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**25**	**19**	**5**	**3**	**33**

Sub Code: BTEE15F6100	**Power System Analysis**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To model the power system under steady state operating condition. To apply efficient numerical methods to solvethe power flow problem. 2. To model and analyze the power systems under abnormal (or) fault conditions. 3. To model and analyze the transient behavior of power system when it is subjected to a fault					
Course Outcomes	At the end of this course, Student will be able to 1. Carry out the fault analysis of transmission and distribution networks. 2. Computation of short circuit capacity analysis 3. Build the impedance matrix algorithms from which the power flow and losses can be estimated					

Unit 1: Introduction to Power System **[14hrs]**

Modern Power System – basic components of a power system. Generator model, transformer model, transmission system model and load representation. Single line diagram – per phase and per unit representation – change of base..

Unit 2: Network Matrices **[14hrs]**

Introduction, Importance of Y-Bus matrix and Z- Bus matrix in Power System Analysis, formation of Y- Bus matrix and Z- Bus matrix , formation of YBUS by method of inspection (including transformer off-nominal tap setting) and method of singular transformation (YBUS = A^TYA), Formation of Bus Impedance matrix by step by step building algorithm

Unit 3: Fault Analysis – Balance Faults **[14hrs]**

Importance short circuit (or) for fault analysis – basic assumptions in fault analysis of power systems. Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents.

Unit 4: Fault Analysis – Unbalanced Faults **[14hrs]**

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis – problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart)

Text Books:

1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, 'Electric Energy Systems Theory – An Introduction', Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

References:

1. P. Kundur, 'Power System Stability and Control, Tata McGraw Hill, Publications,1994.
2. John J. Grainger and W.D. Stevenson Jr., 'Power System Analysis', McGraw Hill International Book Company, 1994.
3. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', Tata McGraw-Hill Publishing Company, New Delhi, 1990.

<table>
<tr><td rowspan="2">Sub Code: BTEE15F6200</td><td rowspan="3">High Voltage Engineering</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">3</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">5</td></tr>
<tr><td>Duration: 14 Weeks</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable the students understand various breakdown mechanisms.
2. To enable the students understand various principles of generating high DC, AC and impulse voltages.
3. To teach the students about various methods for measuring high voltages and currents.
4. To teach the students various high voltage tests performed on various electrical apparatus such as cables, insulators etc.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After the completion of the course the student will be able to:

1. Describe the principles of the generation and measurement of high voltage AC, DC and impulse voltages.
2. Describe the fundamentals of breakdown.
3. Understand discharge phenomena, to prevent them.
4. Know the origins of overvoltage and protection against them.
5. Understand insulation coordination concept</td></tr>
</table>

COURSE CONTENTS

Unit 1: Over Voltages in Electrical Power Systems [**10hrs]**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, need for generating high voltages in laboratory.

Electrical Breakdown in Gases, Solids and Liquids

Gaseous breakdown in uniform and non-uniform fields – Ionization process, Townsend'scurrent growth equation. Streamer theory of breakdown. Paschen's law of gases, Vacuum breakdown – Breakdown in pure and commercial liquids – Breakdown mechanisms in solid dielectrics.

Unit 2: Generation of High Voltages and High Currents **[11hrs]**

HVAC- Cascade connection and working of transformers units connected in cascade. Resonant circuits- principle of operation and advantages. Tesla coil.

HVDC-Voltage doubler circuit, cock croft- Walton type high voltage DC set. Calculation of high voltage regulation, ripple and optimum number of stages for minimum voltage drop.

Impulse Voltages & Currents- Impulse voltage generator, Marx Impulse circuit, Triggering methods of impulse generator. Generation of switching impulse voltages. Generation of high impulse current.

Unit 3: Measurement of High Voltages and High Currents **[11Hrs]**

Electrostatic voltmeter-principle, construction and limitation. Generating voltmeter- Principle, construction. Standard sphere gap measurements of HV AC, HV DC, and impulse voltages.

Potential dividers, their types and applications.

Measurement of high impulse currents- Rogowsky coil and Magnetic Links.

Unit 4: **[10Hrs]**

Non-destructive High Voltage Testing:

Measurable properties of dielectrics.

Measurement of Dielectric properties with Schering Bridge and Mega ohm meter.

Insulation Coordination:

Principle of insulation coordination on high voltage and extra high voltage power systems. Basic insulation level design systems.

Text Books :

1. M.S.Naidu and Kamaraju, ‘High Voltage Engineering’, 4^{th} edition, THM, 2008.
2. E.Kuffel and W.S. Zaengl, ‘High Voltage Engineering Fundamentals’, 2^{nd} edition, Elsevier Press, 2005.
3. C.L.Wadhwa, ‘High Voltage Engineering’ , New Age International Private limited, 1995

<table>
<tr><td>Sub Code: BTEE15F6300</td><td rowspan="2">Theory and Applications of Linear Integrated Circuits</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce the basic building blocks of linear integrated circuits.
2. To outline the design procedure of applications using operational amplifiers, analog multipliers and PLL.
3. To study the operation of ADC and DAC
4. To introduce the concepts of waveform generation and introduce some special function ICs</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">After completion of the course, the student can able to:
1. Describe the fabrication methods and characteristics of op-amp and Timer ICs</td></tr>
</table>

	2. Design different applications using general purpose op- amp and application specific ICs. 3. Design multipliers and PLL, and design of applications using Timer IC

COURSE CONTENTS

Unit 1 : Basics of Op-amps **[12hrs]**

op-amp structure, IC-741 structure and its characteristics, features of Op-amp, Design of Non inverting and Inverting Amplifiers, differential amplifiers, Capacitor coupled voltage follower, capacitor coupled non-inverting amplifier capacitor coupled inverting amplifier, setting upper cut off frequency, capacitor coupled difference amplifier, and use of single polarity supply.

Unit 2: **[12hrs]**

A. Signal processing circuits: Precision half wave &full wave rectifiers, limiting circuits, clamping circuits, peak detectors, Sample & Hold Circuit, A-D and D-A converters.

B. Nonlinear circuits: Op-amps in switching circuits, crossing detectors, inverting Schmitt trigger circuits, non-inverting Schmitt circuits, Astable Multivibrator, and Monostable Multivibrator.

Unit 3: **[12hrs]**

A. Signal generator: Triangular/Rectangular wave generator, waveform generator design, Phase Shift Oscillator, oscillator amplitude stabilization, Wein Bridge Oscillator, signal generators output controllers.

B. Active filters: First and Second Order High Pass And Low Pass Filters, Band Pass Filter, Band Stop Filter.

Unit 4: **[12hrs]**

A. Specialized IC‘s: Universal Active Filter, Switched Capacitor Filter, Phase Locked Loops, Basics of Voltage Regulators, 721 voltage regulator.

B. Other Linear IC’s: 555 timers, Architecture, Astable Multivibrator, Monostable Multivibrator

Text Books:

1. Ramakanth A Gayakwad, ‘Operational amplifiers and linear IC’s’, Pearson, 4th edition, 2007.
2. David A Bell, ‘Operational amplifiers and linear IC’s’, PHI

Reference Books:

1. Roy & Choudry, ‘Operational amplifiers and linear IC’s’, New age International.
2. Stanley William D, ‘Operational amplifiers and linear IC’s’, 4th edition, Pearson Education

Sub Code: BTEE15F6401	**Advanced Control Engineering**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To Understand the basics of mathematical modeling 2. To study the stability analysis of linear and non-linear systems 3. Develop ability to set up measurement systems with a control environment 4. Develop an ability to design and utilize advanced control systems and apply MATLAB RealTime programming to collectprocess data					
Course Outcomes	On completion of this course the students will be able to: 1. Ability to apply knowledge of advanced principles to the analysis of electrical and computer engineering problems. 2. Ability to apply knowledge of advanced techniques to the design of electrical and computer engineering systems. 3. At the end of the course students will be able apply the modeling concepts 4. Students will be equipped with stability analysis of linear and non linear systems					

COURSE CONTENTS

Unit 1: Modern Control Theory **[10hrs]**

Limitations of conventional control theory - Concepts of state, State variables and state model – state model for linear time invariant systems: State space representation using physical-Phase and canonical variables, Characteristic equation - Eigen values and Eigen vectors - Invarianceof Eigen values -Diagonalization - Jordan Canonical form

Unit 2: System Response **[10hrs]**

Transfer function from state model - Transfer matrix - Decomposition of transfer functions Direct, cascade and parallel decomposition techniques - Solution of state equation - State transition matrix computation

Unit 3: System Models **[12hrs]**

Concepts of controllability and observability - Kalman's and Gilbert's tests - Controllable and observable phase variable forms - Effect of pole-zero cancellation on controllability and observability.

Unit 4: Liapunov Stability **[12hrs]**

Liapunov stability analysis - Stability in the sense of Liapunov - Definiteness of Scalar Functions – Quadratic forms - Second method of Liapunov - Liapunov stability analysis of linear time invariant systems

Text Books:

1. Katsuhiko Ogata, ‘Modern Control Engineering’, Prentice Hall of India Private Ltd., New Delhi, Third Edition, 2002.
2. Nagrath I J and Gopal M, ‘Control Systems Engineering’, New Age International Publisher, New Delhi, 2006.
3. Gopal M, ‘Digital Control and State Variable Methods’, Tata McGraw-Hill Publishing Company Limited, NewDelhi, India, Second Edition, 2003.
4. Nise S Norman, ‘Control Systems Engineering’, John Wiley & Sons, Inc, Delhi, Third edition, 2000.
5. Benjamin C Kuo, ‘Automatic Control Systems’, John Wiley & Sons, Inc., Delhi, 2002.

References:

1. Vidyasagar .M, ‘Nonlinear system analysis’, Prentice Hall Inc., New Jersey 2002
2. Singiresu S. Rao, ‘Applied Numerical Methods’, Prentice Hall, Upper Saddle River, New Jersey, 2001.
3. Jean-Jacques E. Slotine, Weiping Li, ‘Applied Nonlinear Control’, Prentice Hall Inc., New Jersey, 2004.

<table>
<tr><td>Sub Code: BTEE15F6402</td><td rowspan="2">Digital Relays</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To introduce students to power system protection using digital relays.
2. To teach students theory and applications of the digital components used in power system protection.
3. To enable the students to understand theory, construction advantages and disadvantages of various digital and numerical relays.
4. To teach the students , the theory and construction of various protective relays and their characteristics
5. To teach students the protection systems used for Power system</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:</td></tr>
</table>

	1. Be able to describe the operation of digital protection system. 2. Be able to classify various types of Static, digital Relays 3. Be able to describe the theory , construction , advantages and disadvantages of different types of Relays and their applications 4. Be able to design distance protection schemes 5. Be able to differentiate electromechanical and digital relays.

COURSE CONTENTS

Unit 1: **[11hrs]**

Static Relays: Introduction, Basic construction, Classification, Basic circuits- Smoothing circuits, Voltage regulation, Square wave generator, Time delay circuits, Level detectors, Summation devices, Sampling circuits, Zero crossing detector and Output devices.

Comparators: Replica Impedance, Mixing Transformers, General equation of Phase and Amplitude comparators, Realization of ohm, mho, impedance and offset impedance characteristics, Duality principle, Static Amplitude comparators-Rectifier bridge circulation current type, Sampling comparator. Static phase comparator- coincidence type rectifier phase comparator, Block split comparator and Zener diode phase comparator.

Unit 2: **[10hrs]**

Static Over Current, Timer and Voltage Relays: Instantaneous OCR, Definite and Inverse time OCR , Static Timer Relays, Monostable delay circuits, Single phase Instantaneous over voltage and under voltage relays, Instantaneous over voltage relay using OP-Amps.

Unit 3: Distance Relays **[11hrs]**

Distance Relays : General Principle of operation, Zone discrimination, Fault area on Impedance diagram, Basic measuring elements, Different characteristics used in distance relaying- Impedance, Reactance, Admittance, Ohm. Distance relay settings, Distance measurements problems.

Unit 4: Principles of Digital and Numerical Relays **[10hrs]**

Definition of Numerical Protection system, Advantages of Numerical Relays, Block representation of Numerical Relays.

Block schematic approach of microprocessor based relays- Over current Protection, Transformer Differential Protection, Directional Relay scheme, Impedance Relay scheme.

Text Books:

1. T.S.Madava Rao, 'Power System Protection, Static Relays with Microprocessor Applications', TMH second addition, 2004
2. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.

Reference Books:

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986.
2. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', Wiley Eastern Ltd., 1977.
3. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003

<table>
<tr><td>Sub Code: BTEE15F6403</td><td rowspan="2">Embedded Systems & IOT</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Provide knowledge about the basics of embedded systems and embedded system design
2. Describe Internet-of-Things and design principles
3. Explain the ease of prototyping and production, and think of deployment for the community.
4. Gain expertise in integrating sensing, actuation and software
5. Give knowledge about internet principles and techniques for writing embedded code</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Explain the basics of embedded systems and design embedded systems
2. Design and Develop Internet-of-Things based applications
3. Develop prototypes of Internet-of-Things based applications, and deploy for the usage of the community.
4. Integrate sensing, actuation and software
5. Write embedded code for constrained sensor devices</td></tr>
</table>

COURSE CONTENTS

Unit 1: Introduction to Embedded Systems [12hrs]

Introduction, Complex Systems and Microprocessors, Embedded Systems Design Process, Formalism for System design, Design Example: Model Train Controller, RTOS vs OS.

Unit 2: The Internet of Things: An Overview & Design Principles [12hrs]

The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things? Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

Unit 3: Thinking about Prototyping and Prototyping Embedded Devices [12hrs]

Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community, Electronics, Arduino, Raspberry Pi, Beagle Bone Black, Electric Imp, And other Notable Platforms.

Unit 4: Internet Principles and Techniques for Writing Embedded Code [12hrs]

Internet Communications, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols, Memory Management, Performance and Battery Life, Libraries, Debugging, Current challenges in IoT.

Text Books:

1. Wayne Wolf, 'Computers as Components: Principles of Embedded Computing System Design', 2nd Edition, Elsevier, 2008.
2. Adrian McEwen, Hakim Cassimally, 'Designing the Internet of Things', Wiley, 2014.
3. Kurose, James F Ross, Keith W, 'Computer networking: a top-down approach', 5th edition, international edition, Boston, Mass Pearson, cop. 2010.

References:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, 'The Internet of Things: Key Applications and Protocols', Wiley, 2015.
2. Frank Vahid, Tony Givargis, 'Embedded System Design: A Unified Hardware/Software Introduction', Wiley, 2006.
3. 'Design Automation for Embedded Systems', Springer.
4. IEEE, IEEE Internet of Things Journal
5. Elsevier, Journal of Network and Computer Applications.
6. Elsevier, Computer Law & Security Review
7. ACM, ACM Transactions on Internet Technology (TOIT)

Sub Code:BTEE15F6404	**DBMS**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. Provide the basic knowledge about the data models and database concepts. 2. Describe conceptual data models and ER diagrams.					

	3. Explain theoretical concepts of the relational data model and the relational algebra. 4. Describe the use of SQL commands for database operations. 5. Illustrate database design concepts and normalization with examples
Course Outcomes	On completion of this course the students will be able to: 1. Apply the knowledge to design database schemas. 2. Design ER diagrams for given data models. 3. Use database concepts and relational models for building database applications. 4. Develop database applications for industrial projects. 5. Demonstrate skills as a database administrator to control both data and application programs

COURSE CONTENTS

Unit 1: Introduction to databases and Conceptual Modelling [12hrs]

Introduction, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues.

Unit 2: Relational Data Model and Relational algebra [12hrs]

Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra.

Unit 3: SQL [12hrs]

SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, Retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

Unit 4: Database Design Theory and Normalization [12hrs]

Informal design guidelines for relation schemas, Functional dependencies, Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

Text Books:

1. Raghu Ramakrishnan and Johannes Gehrke, ‘Database Management Systems’, 3rd Edition, McGraw-Hill, 2003.
2. Elmasri and Navathe, ‘Fundamentals of Database Systems’, 5th Edition, Pearson Education, 2007.

References:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, ‘Database System Concepts’, 6th Edition, McGraw Hill, 2010.
2. C J Date, ‘Database Design and Relational Theory: Normal Forms and All that Jazz’, O ‘Reilly, April 2012.
3. IEEE, IEEE Transactions on Knowledge and Data Engineering
4. Elsevier, Elsevier Data and Knowledge Engineering
5. ACM, ACM Transactions on Database Systems

Sub Code: BTEE15F6501	**Power System Planning and Reliability**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To study the fundamentals of Generation system, transmission system and Distribution system reliability analysis 2. To illustrate the basic concepts of Expansion planning. 3. To introduce the objectives of Load forecasting					
Course Outcomes	On completion of this course the students will be able to: 1. Be able to describe the planning process of the power system. 2. Be able to identify the suitable techniques for load forecasting and modeling. 3. Be able to identify various measures has to taken while planning a power system. 4. Be able to analyze various optimization techniques					

COURSE CONTENTS

Unit 1: System planning & Load forecasting **[14hrs]**

Introduction, Objectives & Factors affecting to System Planning , National and regional planning Short Term Planning, Medium Term Planning, Long Term Planning, structure of power system, planning tools, electricity regulation. Objectives of forecasting - Load growth patterns and their importance in planning, Load Research, Load Growth Characteristics, Classification of Load and Its Characteristics, Load Forecasting Methods - (i) Extrapolation (ii) Co-Relation Techniques, Energy Forecasting, Peak Load Forecasting, Reactive Load

Forecasting, Non-Weather sensitive load Forecasting, Weather sensitive load Forecasting, Annual Forecasting, Monthly Forecasting, Total Forecasting.

Unit 2: Generation Planning and reliability **[14hrs]**

Objectives & Factors affecting Generation Planning, Generation Sources, Integrated Resource Planning, co-generation / captive power, power pooling and power trading, transmission & distribution planning, power system economics, power sector finance, financial planning, private participation, rural electrification investment, concept of rational tariffs. Generation System Model, Loss of Load (Calculation and Approaches), Outage Rate, Capacity Expansion, Scheduled Outage, Loss of Energy, Evaluation Methods, Interconnected System, and Factors Affecting Interconnection under Emergency Assistance.

Unit 3: Power Supply Reliability & Expansion Planning **[14hrs]**

Reliability planning, system operation planning, Evaluation Techniques (i) Markov Process (ii) Recursive Technique, Stochastic Prediction of Frequency and Duration of Long & Short Interruption, Adequacy of Reliability, Reliability Cost. Optimal Power system expansion planning, formulation of least cost optimization problem incorporating the capital, operating and maintenance cost of candidate plants of different types (thermal hydro nuclear Nonconventional etc), Optimization techniques for solution by programming.

Unit 4: Transmission & Distribution Planning **[14hrs]**

Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability. Distribution system-Radial Networks, Network Reconfiguration, Evaluation Techniques, Interruption Indices, Effects of Lateral Distribution Protection, Effects of Disconnects, Effects of Protection Failure, Effects of Transferring Loads, Distribution Reliability Indices.

Text Books:

1. R.L. Sullivan, ‘Power System Planning’, Tata McGraw Hill Publishing Company Ltd, 2012
2. X. Wang & J.R. McDonald, ‘Modern Power System Planning’, McGraw Hill Book Company, 1994.

References:

1. T. Gonen, 'Electrical Power Distribution Engineering', McGraw Hill Book Company, 1986.
2. Roy Billinton & Ronald N. Allan, 'Reliability Evaluation of Power System', Springer Publication, 1986.
3. A.S.Pabla, 'Electrical Power System Planning', Macmillan India Ltd, 1998
4. B.R. Gupta, 'Generation of Electrical Energy' , S. Chand Publications

Sub Code: BTEE15F6502	**Modeling and Simulation of Electrical Machines**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the concept of 2-axis representation of an Electrical machine. 2. To know the concepts of representing transfer function model of a DC machine. 3. To understand the importance of 3-phase to 2-phase conversion. 4. To know the representation of 3-phase induction motor in various reference frames 5. To know the modeling of 3-phase synch. Motor in 2- axis representation					
Course Outcomes	On completion of this course the students will be able to: 1. Develop models for linear and nonlinear magnetic circuits 2. Determine the developed torque in an electrical machines using the concepts of filed energy and co-energy and determine the dynamic model of a DC Machine 3. Determine the dynamic model of an induction machine based on the dq0 transformation and determine instantaneous torque developed in an induction machine-which leads to advanced control strategies such as vector control and direct torque control. 4. Determine the torque developed in a salient pole synchronous machine using the park's transformation and identifycontribution of saliency torque-damping torque and excitation torque					

COURSE CONTENTS

Unit 1: [12hrs]

Basic Two-pole DC machine - primitive 2-axis machine - Voltage and Current relationship - Torque equation. Mathematical model of separately excited DC motor and DC Series motor in state variable form - Transfer function of the motor - Numerical problems. Mathematical model of D.C. shunt motor and D.C. Compound motor in state variable form - Transfer function of the motor - Numerical Problems.

Unit 2: [10hrs]

Linear transformation - Phase transformation (a, b, c to α, β, o) - Active Transformation (α, β, o to d, q). Circuit model of a 3 phase Induction motor – Linear transformation - Phase Transformation - Transformation to a Reference frame - Two axis models for Induction motor.

Unit 3: [10hrs]

Voltage and current Equations in stator reference frame - Equation in Rotor reference frame - Equations in a synchronously rotating frame - Torque equation-Equations in state-space form.

Unit 4: [12hrs]

Circuit model of a 3ph Synchronous motor - Two axis representation of Syn. Motor Voltage and current Equations in state - space variable form - Torque equation.

Text Books:

1. Vedam Subramanyam, ‘Thyristor control of Electric Drives’.
2. Paul C.Krause , Oleg wasynezuk, Scott D.Sudhoff, ‘Analysis of Electric Machinery and Drive Systems’

References:

1. Fitzgerald and Kingsley, ‘Electric Machinery’
2. O'Simmons and Kelly, ‘Introduction to Generalized Machine Theory’.
3. Hancock, ‘Matrix Analysis of Electric Machinery’.

Sub Code: BTEE15F6503	**Operation research**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the quantitative methods for effective decision making. 2. To study the various techniques for effective decision making to solve business decision problems. 3. To understand the model formulation and applications in business decision making.					
Course Outcomes	On completion of this course the students will be able to: 1. Knowledge and understanding - Be able to understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.					

	2. Cognitive skills (thinking and analysis) - Be able to build and solve Transportation Models and Assignment Models. 3. Communication skills (personal and academic) - Be able to design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.

COURSE CONTENTS

Unit 1: Linear Programming **[12hrs]**

Introduction, Linear Programing, Formulation of linear programing problem, simplex method, computational procedure, Big-M method, two phase simplex method

Degeneracy, Alternative optional solutions, Duality in LPP, primal-dual relation, Formulation of dual problem, primal-dual optional solution, Dual simplex method

Unit 2: **Game Theory** **[8hrs]**

Introduction to optimal strategies, solution of 2 x 2, 2 x n, m x 2 games, Concept of dominance, Graphical method of solving, Sequencing problems, n-jobs and two machines, n-jobs and three machines, two jobs and m machines

Replacement theory, Introduction, Replacement considering both the cases with and without tie value of money

Unit 3: **Pert- CPM Techniques** [**10hrs]**

Network construction, Determining critical path & floats, Scheduling by network, project duration, Variance under probabilistic modes, prediction of date of completion, Crashing of simple networks

Unit 4:

Assignment Problems **[10hrs]**

Introduction & Assignment problems, Formulation, Hungarian method of solving assignment problems, travelling salesman problems

Transportation Problems

Basic feasible solution by different methods, fixing optimal solutions-stepping stone method, MODI method.

Text Books

1. Ackoff.R.L and Sasieni.M.W, ‘Fundamentals of Operations Research’, Wiley Eastern limited, New Delhi
2. Wayne.L Winston, ’Operations Research Applications and Algorithms’, Cengage learning,4th edition,2009
3. Bronson.R, ‘Operations Research’, Schaum’s Outline Series, McGrawHill international,2nd edition
4. S.D. Sharma , ‘Introduction to Operations Research’ , Gillet,B.E., TMH 1979

<table>
<tr><td>Sub Code: BTEE15F6504</td><td rowspan="2">Web Programing</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable the students understand various steps in designing a creative and dynamic website.
2. To enable the students understand markup languages.
3. To enable students in designing dynamic and interactive web pages by embedding Java Script code in HTML.
4. To familiarize advantages and use of different types of CSS.
5. To familiarize server side scripting language like PHP</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Describe the concepts of WWW including browser and HTTP protocol.
2. Summarize the various HTML tags and use them to develop the user friendly web pages.
3. Define the CSS with its types and use them to provide the styles to the web pages at various levels.
4. Develop the modern web pages using the HTML and CSS features with different layouts as per need of applications.
5. Apply JavaScript to develop the dynamic web pages.
6. Use server side scripting with PHP to generate the web pages dynamically using the database connectivity.
7. Formulate the modern Web applications using the client and server side technologies and the web design fundamentals</td></tr>
</table>

COURSE CONTENTS

Unit 1: Introduction to Web programming [**10hrs]**

Web Essentials: Clients, Servers, and Communication. Internet Standards ,Introduction to WWW, WWW Architecture ,SMTP, Web Browsers and Web Servers, URLs, File Transfer Protocol - Overview of HTTP, HTTP request ,response ,Generation of dynamic web pages, Security.

Unit 2: UI Design **[11hrs]**

Markup Language (HTML): Introduction to HTML, Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms.

Cascading Style Sheet (CSS): The need for CSS, Introduction to CSS, Basic syntax and structure, Inline Styles, Embedding Style Sheets, Linking External Style Sheets, Backgrounds, Manipulating text, Margins and Padding, Positioning using CSS.

Unit 3: JAVA Script **[11hrs]**

Introduction: Overview of Java Script, Object orientation and Java Script, Data types and Variables - Operators, Expressions, and Statements - Functions - Objects - Array, Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations, Errors in scripts, Examples.

Unit 4: PHP **[10hrs]**

Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP. PHP and MySQL: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs

Text Books:

1. Deitel, Goldberg, 'Internet & World Wide Web How to Program', Third Edition, PearsonEducation,2006.
2. Marty Hall and Larry Brown, 'Core Web Programming', Second Edition, Volume I and II, PearsonEducation,2001.
3. Bates, 'Developing Web Applications', Wiley, 2006.
4. David Flanagan, 'JavaScript: The Definitive Guide, Sixth Edition', O'Reilly Media, 2011
5. Steven Holzner, 'The Complete Reference – PHP', Tata McGraw Hill, 2008
6. Mike Mcgrath, 'PHP & MySQL in easy Steps', Tata McGraw Hill, 2012.
7. ELSEVIER Journals within "Internet And Web Technology"

<table>
<tr><td>Sub Code:BTEE15F6601</td><td rowspan="2">Smart Grid</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>2</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
2. To understand the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.
3. To understand the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System, Phase Measurement Unit.
4. To understand the concept of microgrid and its integration with main central grid.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Differentiate Conventional and Smart Grid.
2. Adopt smart meters in industries and residential sector
3. Identify the need of Smart Grid, Micro Grid, Smart metering, Smart storage, Hybrid Vehicles, Home Automation, Smart Communication.
4. Use smart technologies that will enhance the reliability and energy efficiency of distribution system.
5. Comparing and getting acquainted with emerging technologies and current professional issues in electric Grid
6. Implement the use of renewable energy systems in the distribution system.</td></tr>
</table>

COURSE CONTENTS

UNIT – I Introduction to Smart Grid [14hr]

Concept of Smart Grid, Definitions, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Smart Grid Vision & Roadmap for India, Present development & International policies in Smart Grid, Smart Cities, Pilot projects in India. Smart Grid Technologies: Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid (V2G), Grid to vehicles (G2V),

UNIT – II Smart Meters and Advance Metering Infrastructure [14 hr]

Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home & Building Automation, Geographic Information System (GIS).
Smart storage technologies: Battery (flow and advanced), SMES, Super Capacitors, Pumped Hydro, Compressed Air Energy Storage (CAES) and its comparison.

UNIT – III Microgrids [14 hr]

Concept of Microgrid, need & applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection & control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, modeling of PV and wind systems, islanding

UNIT – IV Communication Technology for Smart Grid [14 hr]

Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid, Broadband over Power line (BPL), IP based protocols.

TEXT BOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley Publications.
4. Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press, Taylor and Francis group
5. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid Technology and applications", Wiley Publications.
6. James Momoh, "Smart Grid-Fundamentals of design and analysis", Wiley Publications.

Reference books:

1. Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley Publications.

2. Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press, Taylor and Francis group.
3. Lars T. Berger and Krzysztof Iniewski, “Smart Grid-Applications, Communications and Security”, Wiley Publications.
4. Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert “Substation Automation (Power Electronics and Power Systems)”, Springer Publications.
5. Stephen F.Bush, “Smart Grid-Communication Enabled Intelligence for the Electric Power Grid”, IEEE Press, Wiley Publications
6. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw Hill Publication.
7. Jean Claude Sabonnadière, Nouredine Hadjsaïd, “Smart Grids”, Wiley Blackwell

Sub Code: BTEE15F6602	**Digital Signal Processing**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. Apply digital signal processing fundamentals. 2. What are the key DSP concepts and how do they relate to real applications? 3. Master the representation of discrete-time signals in the frequency domain, using z-transform, discrete Fourier transform (DFT), and cosine transform. 4. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications 5. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses. 6. Appreciate relationships between first order low pass, and high pass filters, and between second-order Peaking and Notching filters. Design digital filters using Matlab					
Course Outcomes	On completion of this course the students will be able to: 1. Represent discrete-time signals analytically and visualize them in the time domain. 2. Understand the meaning and implications of the properties of systems and signals. 3. Understand the Transform domain and its significance and problems related to computational complexity. 4. Be able to specify and design any digital filters using MATLAB					

<u>COURSE CONTENTS</u>

Unit 1: Discrete Fourier Transforms **[14hrs]**

Definitions, properties-linearity, shift, symmetry etc, circular convolution –periodic convolution, use of tabular arrays, circular arrays, stock hams's method, linear convolution –two finite duration sequence, one finite & one infinite duration, overlap add and save methods..

Unit 2: Fast Fourier Transforms Algorithms [14hrs]

Introduction, decimation in time algorithm, first decomposition, number of computations, continuation of decomposition, number of multiplications, computational efficiency, decimation in frequency algorithms, algorithm, inverse decimation in time and inverse decimation in frequency algorithms, decomposition for a composite number N=9.

Unit 3: Design of IIR&FIR Digital Filters [14hrs]

Introduction, impulse invariant & bilinear transformations, all pole analog filters- Butterworth & chebyshev, design of digital Butterworth & Chebyshev, frequency transformations FIR: Introduction, windowing, rectangular, modified rectangular, Hamming, Hanning, blackman window(excluding Kaiser window), frequency sampling techniques.

Unit 4: Digital Filter Structures [14hrs]

Realization of digital filters, Basic building blocks of digital filter, structures for IIR system, direct form, cascade form and parallel form structures, structures for FIR system, direct form, cascade form and lattice structures.

Text Books:

1. Proakis, 'Digital Signal Processing Principle, Algorithm & application', Pearson, 4th edition, 2009.
2. Sanjeet. K. Mitra, 'Digital Signal Processing', TMH, 3rd Edition, 2009.

Reference Books:

1. Johnny R. Johnson, 'Introduction to Digital Signal Processing', PHI, 2009.
2. Openheim, 'Discrete Time Signal Processing', Pearson 2nd edition, 2009.
3. S. Salivahanan, A. Vallaraj, C.Gnanapriya, 'Digital Signal Processing', TMH, 2nd Edition, 2010.
4. Ifeachor Emmauel, 'Digital Signal Processing', Pearson education, 2nd Edition, 2006.
5. Ludeman,John Wiley, 'Fundamentals of Digital Signal Processing', 3rd Edition, 2008

<table>
<tr><td>Sub Code: BTEE15F6603</td><td rowspan="2">VLSI Circuits and Design</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To give clear idea about the basics of VLSI design and its importance.
2. To know about the operating principles of MOS transistor.
3. To understand the basics of MOS process Technology.
4. To study about construction of NMOS, CMOS and Bi-CMOS based logic gates.
5. To understand the necessity of testing and the design strategy of the same</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Understand the characteristics of CMOS circuit construction.
2. To demonstrate the fundamentals of IC technology such as various MOS fabrications.
3. To calculate electrical properties of MOS circuits such as Ids - Vds relationships.
4. To design various gates, adders, Memories, using stick diagrams</td></tr>
</table>

COURSE CONTENTS

Unit 1: Introduction **[11hrs]**

Introduction to Integrated Circuit Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies; Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation, Integrated Resistors and Capacitors.

Basic Electrical Properties

Drain to source current Ids versus Vds relationships-BICMOS latch up susceptibility. MOS transistor characteristics, figure of merit, pass transistor NMOS and COMS inverters,Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

Unit 2: VLSI Circuit Design Processes [**10hrs]**

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits .

Gate Level Design

Logic Gates, Switch logic, Alternate gate circuits, Time delays, Driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out, Choice of layers.

Unit 3: Data Path Subsystems **[15hrs]**

Subsystem Design, Shifters, Adders, ALUs, Parity generators, Comparators, Zero/One Detectors, Counters.

Array Subsystems:

SRAM, DRAM, ROM, Serial Access Memories, Content Addressable Memory.

Unit 4: COMS Testing **[6hrs]**

CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Text Books:

1. Douglas Pucknell & Eshragian, 'Basic VLSI Design', PHI, 3rd Edition.
2. John .P. Uyemura, 'CMOS Logic Circuit Design', Springer.
3. Neil Weste, 'Introduction to CMOS VLSI Design- A Circuits and Systems Perspective', Pearson Education, 3rd Edition

Sub Code: BTEE15F6604	**Data Structures using C++**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. Introduce the basic concepts for defining classes with data and member functions. 2. Explain the knowledge of structure, operations and applications of various data structures like arrays, structures, unions, lists, stacks, queues, trees, graphs, hash tables and heaps. 3. Provide the students with solid foundations in the basic concepts of programming: data structures and algorithms. 4. Familiarize the concept of Abstract Data Types (ADT) 5. and Implement ADT in several programming languages					

Course Outcomes	On completion of this course the students will be able to: 6. Implement classes and objects for a given problem. 7. Demonstrate the ability of accessing members in the written programs. 8. Impart the effectiveness of data structures and algorithms for solving a given problem. 9. Package a set of data structures and algorithms as an 10. abstract data type.

COURSE CONTENTS

Unit 1: **[10hrs]**

Introduction: Overview of C++, Introduction to variables in C++, I/O operators, Function overloading, Inline function, Recursive function.

Classes & Objects: Introduction to Classes, Member Functions and Member data, Constructors and Destructors, The scope resolution operator, Static Class members.

Introduction to Objects, Array of Objects, Dynamic Objects, Pointers to objects, Friend Function

Unit 2: **[11hrs]**

Introduction to Data structures and Algorithms: Data, Data Types, Abstract Data Types and Examples, Algorithms, Arrays: One Dimensional and Two Dimensional, Structures: Introduction to structures and nested structures.

Unit 3: Data Structure-I **[11hrs]**

Pointers: Introduction, Recursion, Stacks, Queues: Simple, circular and priority Queues, Linked Lists: Singly and Doubly Linked List.

Unit 4: Data Structure-II **[10hrs]**

Trees: Terminologies and types, Binary Trees, Binary Search Trees, Tournament Trees, Heaps, Hash Tables, Graphs and Algorithms: Basic Terminologies and BFS DFS Algorithm

Text Books:

1. HerbertSchildt, 'The Complete Reference C++', 4th Edition, Tata McGraw Hill, 2003.
2. SanleyB.Lippmann, JoseeLajore, 'C++ Primer', 4th Edition, Pearson Education, 2005.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 'Introduction to

Algorithms', IT Press, 2002
4. Horowitz, Sahni, Anderson-Freed, 'Fundamentals of Data Structures in C', 2nd Edition, Universities Press, 2007

Reference Books:

1. Paul J Deitel, Harvey M Deitel, 'C++ for Programmers', Pearson Education, 2009.
2. K R Venugopal, RajkumarBuyya, T Ravi Shankar, 'Mastering C++', Tata McGraw Hill, 1999.
3. ACM, ACM Transactions on Programming Languages and Systems (TOPLAS)
4. Joshi, 'Data Structures and Algorithms in C', Tata McGraw-Hill Education, 2010
5. Richard Gilberg, Behrouz Forouzan,Data Structures, 'A Pseudo code Approach with C', Cengage Learning, 2004

Sub Code: BTEE15F6700	**Electrical Machines Laboratory- II**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Weeks		**2**	**1**	**0**	**1**	**3**
Course Objectives:	1. The ability to conduct testing and experimental procedures on different types of electrical machines. 2. To give an insight into usage of software packages like MATLAB for the realization of circuits without actually exciting them. 3. To enable the student to understand the working of circuits. 4. To practice different types of wiring and devices connections. 5. TO create capability to analyze the operation of electric machines under different loading conditions					
Course outcomes	At the end of this course, Student will be able to: 1. Be able to feel the hands on experience. 2. Understand the concept of efficiency and the short circuit impedance of a three-phase transformer from no-load test, winding resistance, short circuit test, and load test. 3. Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors. 4. Experimentally obtain the load characteristics, starting current and starting torque for series and shunt motors					

List of Experiments:

1. Determination of regulation of alternator by Synchronous Impedance method; Determination of regulation of alternator by zero power factor method; 'V' and 'Λ' curves of Synchronous

Motor; Measurement of Xd & Xq of synchronous machine;
2. Parallel Operation of 3 Phase Alternator with infinite Bus Bar
3. Determination of efficiency of DC machine through Hopkinson s Test.
4. Speed control of DC motor by Ward-Leonard method
5. magnetization characteristic of separately excited DC generator and self-excited dc machines
6. Retardation Test on DC motor
7. V and inverted v curves of synchronous motor
8. MATLAB SIMULATION of dc motor characteristics and speed control
9. Slip test on synchronous generator
10. Swinburne’s test on dc motor

Sub Code: BTEE15F6800	**Control System Laboratory**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Weeks		**2**	**1**	**0**	**1**	**3**
Course Objectives:	1. To enable students to understand the usage of discrete components and operation of measuring and testing equipment. 2. To give an insight into usage of software packages like MATLAB/SCILAB for the realization of physical modules without actually exciting them. 3. To enable the student to understand the importance of transfer function in control system					
Course outcomes:	At the end of this course, Student will be able to: 1. Be able to understand the usage of measuring and testing equipment for different applications. 2. Be able to feel the hands on experience. 3. Be able to learn to formulate mathematical models for other physical quantities					

List of Experiments:

1. Using MATLAB/SCILAB

a) Simulate a typical second order system and determine its step response and evaluate the time- domain specifications.

b) Evaluate the effect of additional poles and zeroes on time response of second order system.

c) Evaluate the effect of pole location on stability

d) Evaluate the effect of loop gain of a negative feedback system on stability

2. a) Design a passive RC lead compensating network for the given specifications, viz., the maximum phase lead and the frequency at which it occurs and to obtain its frequency response.

   b) Determine experimentally the transfer function of the lead compensating network and verify the same with simulation.

3. a) Design RC lag compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.

   b) Determine experimentally the transfer function of the lag compensating network and verify the same with simulation.

4. a) Design RC lag-lead compensating network for the given specifications., viz., the maximum phase lag and the frequency at which it occurs, and to obtain its frequency response.

   b) Determine experimentally the transfer function of the lag compensating network and verify the same with simulation.

5. Study the effect of P, PI, PD and PID controller on the step response of a feedback control system (using control engineering trainer/process control simulator). Verify the same by simulation.

6. a) Conduct an experiment to draw the speed – torque characteristic of a two - phase A.C. servomotor.

   b) Conduct an experiment to draw speed torque characteristic of a D.C. servomotor.

7. Determine experimentally the frequency response of a second -order system and evaluation of frequency domain specifications.

8. Using MATLAB/SCILAB
   a) Simulate a D. C. position control system and obtain its step response
   b) Verify the effect of the input wave form, loop gain system type on steady state errors.
   c) Perform a trade-off study for lead compensation
   d) Design a PI controller and study its effect on steady state error

9. Using MATLAB/SCILAB
   a) Examine the relationships between open-loop frequency response and stability, open loop frequency and closed loop transient response

b) Study the effect of addition closed loop poles and zeroes on the closed loop transient response

10. Using MATLAB/SCILAB

a) Examine the effect of open loop zeroes on root locus contour

b) Estimate the effect of open loop gain on the transient response of closed loop system by using Root locus

c) Carryout a comparative study of Bode, Nyquist and Root locus with respect to Stability.

11. Conduct an experiment to draw to synchro-pair characteristics

VI Semester

SL	Course Code	Title of the Course	HC/SC/OE	C	L	T	P	CH
1	BTEE15F7100	Computer Aided Power System Analysis and Stability	HC	4	3	1	0	5
2	BTEE15F7200	CAED	HC	4	3	1	0	5
2	BTEE15F7300	Project Phase I	HC	2	0	1	1	4
4	BTEE15F7401	Power System Protection	SC	4	3	1	0	5
	BTEE15F7402	HVDC						
	BTEE15F7403	Industrial Instrumentation and Automation						
	BTEE15F7404	Operating system						
5	BTEE15F7501	Testing and Commissioning of Electrical Equipment	SC	4	3	1	0	5
	BTEE15F7502	Electricity Regulations						
	BTEE15F7503	Non Conventional Energy Sources						
	BTEE15F7504	Fuzzy logic system						
6	-	Open Elective subject offered by other school	OE	4	3	1	0	5
7	BTEE15F7700	Relay and High Voltage Laboratory	HC	2	1	0	1	3
8	BTEE15F7800	Power System Simulation Laboratory	HC	2	1	0	1	3
TOTAL CREDITS				**26**	**17**	**6**	**3**	**35**

Sub Code: BTEE15F7100	**Computer Aided Power System Analysis and Stability**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To enable students to understand the basics of network topology and its relevance in 2. Power System Analysis 3. To enable students to understand the analysis of power system network topologies 4. To enable students to learn the concept of power flow and its analysis by different 5. methods 6. To enable students to understand different methods of stability analysis by different techniques					
Course Outcomes	On completion of this course the students will be able to: 1. able to identify the incidence of elements of given power system network 2. able to solve different examples related to network topology 3. able to identify state of the power system through different load					

	flow techniques 4. able to demonstrate stability of power system through different methods

COURSE CONTENTS

Unit 1: Network Topology [11hrs]

Introduction, Elementary graph theory – oriented graph, tree, co-tree, basic cut-sets, basic loops; Incidence matrices – Element-node, Bus incidence, Tree-branch path, Basic cut-set, augmented cut-set, Basic loop and Augmented loop, Primitive network – impedance form and admittance form.

Unit 2: Load Flow Studies [17hrs]

Introduction, Power flow equations, Classification of buses, Operating constraints, Data for load flow, Gauss-Seidal Method – Algorithm and flow chart for PQ and PV buses (numerical problem for one iteration only), Acceleration of convergence; Newton Raphson's Method –Algorithm and flow chart for NR method in polar coordinates (numerical problem for one iteration only). Algorithm for Fast Decoupled load flow method, Comparison of Load Flow Methods.

Unit 3: Stability Analysis [12hrs]

Importance of stability analysis in power system planning and operation – classification of power system stability – angle and voltage stability – simple treatment of angle stability into small- signal and large-signal (transient) stability. Single Machine Infinite Bus (SMIB) system: Development of swing equation – equal area criterion –determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

Unit 4: Transient Stability Studies [16hrs]

Numerical solution of Swing Equation – Point-by-point method, Modified Euler's method,Runge-Kutta method, Milne's predictor corrector method. Representation of power system for transient stability studies – load representation, network performance equations. Solution techniques with flow charts.

Text Books

1. Stag G. W and EI-Abiad, A. H, 'Computer Methods in Power System Analysis', McGraw Hill International Student Edition, 1968.

2. Pai, M. A, ‘Computer Techniques in Power System Analysis’, TMH, 2nd edition, 2005.
3. Nagrath, I. J., and Kothari, D. P, ‘Modern Power System Analysis’, TMH, 3rd Edition, 2003.
4. Singh, L. P, ‘Advanced Power System Analysis and Dynamics’, New Age International (P) Ltd, New Delhi, 2001.
5. Dhar, R. N, ‘Computer Aided Power System Operations and Analysis’, TMH, 1984.
6. Haadi Sadat, ‘Power System Analysis, TMH, 2nd Edition, 12th reprint, 2007

Sub Code: BTEE15F7200	**CAED**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**0**	**1**	**5**
Course Objectives	1. To understand the basics of concept of engineering drawing through AUTO CAD software. 2. To provide an overview of various sectional views of electrical machines. 3. To understand the basic sense of measurement. 4. To provide an insight into various dimensions of equipment used in transmission and distribution.					
Course Outcomes	On completion of this course the students will be able to: 1. Work with Auto CAD 2D classic and execute the basic commands of auto cad software 2. Draw the isometric and orthographic views of given objects 3. Draw the sectional views of Electrical Machines 4. Differentiate between single and three phase systems 5. Implement the knowledge of CAD and EE drawing in design of real time application					

COURSE CONTENTS

Unit 1 : Introduction to Computer Aided Drawing **[14hrs]**

Launching AutoCAD, Choosing Auto CAD classic workspace**,** Understanding basic toolbars, Drawing setting commands , Basic commands, Coordinate systems in Auto CAD, different types of lines, Dimensioning systems ,Methods of dimensioning diameters, radius, angular, Aligned dimensioning , Linear dimensioning, Radial dimensioning, Dimension style.(The dimensioning can be done with each one example), Isometric projections, isometric projections of rectangular objects like cube , prism, pyramids, cone, cylinder and sphere. Isometric projection of step block V block, cross. Orthographic projections , projection ofpoint in all quadrants ,projection of straight lines, projections of triangular, square, pentagonal, hexagonal and circular in current positions. Description of sectional views i.e. plan view , elevation view , end view with 1 e.g.\

Unit 2: Electrical Machines **[14hrs]**

Electrical machine assembly drawing using designs data or sketches or both.

(a) Transformers Assembly - sectional views of single and three phase Core and Shell type Transformers.

(b) Alternator Assembly – sectional views of stator and rotor separately. (Demo)

(c) D.C. Machine Assembly- sectional views of yoke, armature and commutator dealt separately.

(d) Induction Motor Assembly - sectional views of stator and rotor separately.

Unit 3: Winding diagrams **[14hrs]**

Developed winding diagrams of D.C. machines – Simplex and multiplex double layer Lap and Wave windings.

Developed winding diagrams of A.C. machines Integral and Fractional slot double layer Lap and Wave windings. Single line diagrams of various Substations,(Transformer substations only)

Unit 4: Diagrams of Transmission & Distribution Equipment's **[14hrs]**

Draw: Single line diagrams of various Substations,(Transformer substations only) , Transmission Towers-110/220 KV single circuit and double circuit with dimensions, 220KV 'Y' Type single circuit Steel tower, Pin insulator 11KV, 33 KV Underground Cable for 11KV single core and three core Electrical Wiring plan of a residential building to be wired up with AEH installation (Load calculation, Heating and Lighting Circuit) , Electrical wiring plan of anElectric laboratory using standard symbols , Plate &Pipe Earthing.

Text Books :

1. M Yogesh, BS Nagaraja, N Nandan, 'Computer Aided Electrical Drawing', First edition PHI 2014
2. SF Devalapur, 'Electrical Drafting', EBP, Seventh edition, 2006

Reference Books :

1. MS Indira ,V D Shankarlal , D Buela, 'CAD for Electric Engineers', First Edition, Elsevier learning, 2014
2. K R Goplalkrishna, 'Engineering Drawing', 2nd Edition
3. S K Bhattacharaya, 'Electrical Engineering Drawing', New age international publishers (Revised Second edition), 2010

4. https://sites.google.com/site/caedbymaheshkumar/

Sub Code: BTEE15F7300	Project Phase - I	C	L	T	P	CH
Duration: 14 Weeks		2	0	1	1	4
Course Objectives	1. To Articulate a clear research question or problem and formulate a hypothesis 2. To identify and demonstrate appropriate research methodologies and know when to use them 3. To define, articulate and use terminology, concepts, and theory in their field and know how to use them 4. To use library and other tools to search for existing body of research relevant to their topic 5. To know existing body of research relevant to their topic and explain how their project fits 6. To identify and practice research ethics and responsible to conduct in research					
Course Outcomes	On completion of this course the students will be able to: 1. Define research problem and formulate the hypothesis 2. Demonstrate research methodologies 3. Define terminology and understand the concepts related to the same 4. Do rigorous literature survey based on the problem defined 5. Compare the existing body of research and their proposed work 6. Practice research ethics 7. To document the problem definition, objectives and research methodology chosen to proceed in the form of Synopsis					

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines

Guidelines for the Evaluation:

1. Student has to submit a synopsis and give the preliminary presentation during C1 which carries 20% of the total marks
2. Students has to submit a report which is the documentation of the literature survey carried

out and need to give a presentation of the project work , during C2, which carries 20% of the total marks

3. Students has to submit Project phase 1 report and need to give a presentation of the project work, during C3, which carries 60% of the total marks
4. All the above reports must undergo a plagiarism check which should not exceed 25% and failing which lead to resubmission

<table>
<tr><td>Sub Code: BTEE15F7401</td><td rowspan="2">Power System Protection</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To understand the methods of representation of systems and to desire their transfer function models reduction of blockdiagrams.
2. To provide adequate knowledge in the time response of systems and steady state error analysis, different types of controller.
3. To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems & to understand the concept of stability of control system and methods of stability analysis.
4. To study the three ways of designing compensation for a control system and state space analysis</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Describe the operation of switch gear and protection system.
2. Classify various types of Circuit Breakers and Relays
3. Explain the theory, construction, advantages and disadvantages of different types of Circuit Breakers and Relays.
4. Describe protection schemes for transformers, alternators and induction motors
5. List the applications of circuit breakers and relays in real life</td></tr>
</table>

COURSE CONTENTS

Unit 1: **[10hrs]**

Fuse: Introduction to fuse, fuse law, cut -off characteristics, Time current characteristics, HRC fuse, liquid fuse, Application of fuse

Switch Gear: Circuit breaker: Basic Principle of operation , DC and AC Circuit breaking phenomena of arc, properties of arc, initiation , maintenance and Interruption of arc.

Unit 2: **[10hrs]**

Circuit Breakers: Air Circuit breakers – Air break and Air blast Circuit breakers. SF6 breaker - Preparation of SF6 gas, Puffer and non Puffer type of SF6 breakers.Vacuum circuit breakers - principle of operation and constructional details. Advantages and disadvantages of different types of Circuit breakers.

Unit 3: [**10hrs]**

Protective Relays: Basic definitions associated with protective Relaying. Principle of operation of Electromagnetic Relays and Classification. over current relays - Non-directional and directional over current relays, IDMT and Directional characteristics. Differential relays – Principle of operation, percentage differential relay and its characteristics. Distance relays- Impedance relay, Reactance relay, Mho relay. Buchholz relay, Negative Sequence relay.

Unit 4: **[10hrs]**

Protection Schemes: Generator Protection - prime mover faults, stator and rotor faults, Merz price protection, protection against abnormal conditions - unbalanced loading, loss of excitation, over speeding. Transformer Protection - Differential protection, differential relay with harmonic restraint. Induction motor protection - Protection against phase fault, ground fault , single phasing, phase reversal and over loading.

Text Books:

1. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of Power System Protection', Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003
2. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGrawHill, 2001.

Reference Books:

1. Sunil S. Rao, 'Switchgear and Protection', Khanna publishers, New Delhi, 1986.

2. B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', WileyEastern Ltd., 1977.

Sub Code: BTEE15F7402	HVDC	C	L	T	P	CH
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the necessity of HVDC Transmission, how it differs from AC transmission, advantages and disadvantages, planning issues, applications and latest developments. 2. To understand the concepts of HVDC converter, control of HVDC system, how faults occur and protection against thesame. 3. To understand the function of smoothing reactor, dc line, power flow analysis and MTDC systems. 4. To understand how to simulate HVDC system related circuits in MATLAB and SIMULINK					
Course Outcomes	On completion of this course the students will be able to: 1. Understand what HVDC system is, how it differs from AC, why it is required, and what are the advantages and disadvantages. 2. Understand how the control of HVDC system is achieved, the faults in the HVDC system and how protection is done against the same. 3. Understand the function of smoothing reactor, various concepts of DC line, power flow analysis and MTDC systems. 4. Simulate in MATLAB and Simulink, the HVDC power transmission related circuits					

COURSE CONTENTS

Unit 1:
General Aspects of Dc Transmission and Comparison of it with AC Transmission [10hrs]

Historical sketch, constitution of EHV AC and DC links, Limitations and Advantages of AC and DC Transmission.

Unit 2: Converter Circuits [10hrs]

Valve Characteristics, Properties of converter circuits, assumptions, single phase, three phase converters, choice of best circuits for HV DC circuits.

Unit 3: Analysis of the Bridge Converter [10hrs]

Analysis with grid control but no overlap, Analysis with grid control and with overlap less than 60 degree, Analysis with overlap greater than 60 degree, complete characteristics of rectifier, Inversion.

Unit 4: Control of HVDC Converters and Systems [10hrs]

Grid control, basic means of control, power reversal, limitations of manual control, constant current versus constant voltage, desired feature of control,actual control characteristics, constant -minimum -Ignition –angle control, constant –current control,constant –extinction –angle control, stability of control.

NOTE: Assignments to be given on MATLAB simulation (any Two)

1. **Simulation**: Thyristor based HVDC link and VSC based HVDC link simulation using MATLAB and Simulink.
2. **Simulation:** HVDC fault analysis simulation using MATLAB and Simulink
3. **Simulation**: SVC and STATCOM simulation using MATLAB and Simulink.
4. **Simulation**: MATLAB and Simulink simulation of a simple HVDC system transmission system with a 6 pulse converter to study the steady state and transient response.

Text Books:

1. EW Kimbark, “Direct current transmission”,
2. Prabha Kundur, ‘Power System Stability and Control’, TMH, 9th reprint,2007
3. Jos Arrillaga,Y.H.Liu and Mevelle R Watson, ‘High Voltage Power Transmission: The HVDC Options’, Wiley Interscience.
4. K.R.Padiyar,’High voltage DC Power Transmission system’, New Age International Publishers Ltd

Sub Code: BTEE15F7403	Industrial Instrumentation and Automation	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5
Course Objectives	1. Learn about the types of transducers for industrial applications. 2. Bring out the various measurements involved in Power Plants. 3. Familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines & their control 4. Know about the tools like PLC, DCS, and SCADA					
Course Outcomes	On completion of this course the students will be able to: 1. Select instruments and transducers for various physical variables. 2. Get an insight on data acquisition, processing and monitoring system. 3. Design various signal conditioning systems for transducers. 4. Understand the programming realization of PLC					

COURSE CONTENTS

Unit 1: Introduction to Process Control **[11hrs]**

Block diagram of process control loop, definition of elements. Sensor time response - first and second order responses. Review of Transducers: Characteristics and Choice of transducer- factors influencing choice of transducer.

Applications of Transducers - Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement- Torsional, shearing stress and rotating shaft Torque measurement using strain gauge. Flow measurement: Hotwire anemometer, constant resistance Constant current type Eddy current sensors, Variable reluctance tachometers Phase measurement. Analog and digital phase detectors.

Unit 2: Signal conditioning circuits **[10hrs]**

Instrumentation amplifiers, Unbalanced bridge. Bridge linearization using op amp Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimisation.

Measurements in Power Plants

Electrical measurements – current, voltage, power, frequency, power factor. Non electrical parameters- flow of feed water, fuel, air and steam with correction factor for temperature- steam pressure & steam temperature –drum level measurement-radiation detector – smoke density measurement – dust monitor.

Unit 3: Monitoring & Control in Power Plants **[11hrs]**

Speed, Vibration, Shell temperature monitoring and control – steam pressure Control – lubricant oil temperature control –Pollution monitoring- cooling system.

Overview of Automation System

Architecture of Industrial Automation Systems, Different devices used in Automation Actuators, definition, types, selection. Pneumatic, Hydraulic, Electrical, Electro-Pneumatic and valves, shape memory alloys.

Unit 4: Introduction to Sequence Control **[10hrs]**

PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO's, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming- realization of AND, OR logic, concept of latching, Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC.

Text Books:

1. Curtis D. Johnson, 'Process Control Instrumentation Technology', 7th Edition, Pearson Edition, Pearson Education, New Delhi, 2002 / PHI.
2. DVS. Murty, 'Transducers and Instrumentation' Second Edition, PHI Learning Pvt Ltd New Delhi ,2013
3. K Krishnaswamy, M. Ponni Bala, 'Power Plant Instrumentation', Second Edition, PHI Learning Pvt Ltd, New Delhi, 2013
4. Madhuchhanda Mitra, Samarjit Sengupta, 'Programmable Logic Controllers and Industrial Automation An Introduction', Penram International Publishing (India) Pvt Ltd., 2009

References:

1. Doeblin E.O, 'Measurement Systems: Application and Design, Fourth Edition, McGraw Hill, Newyork, 1992
2. G.K.McMillan, 'Process/Industrial Instrument and control and hand book' McGraw Hill, New York,1999
3. R K Jain, Mechanical & Industrial Measurements, Khanna Publishers, New Delhi, 1995.

<table>
<tr><td>Sub Code: BTEE15F7404</td><td rowspan="2">Operating Systems</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Introduce the history, basics and structure of Operating System
2. Describe process concepts and scheduling techniques
3. Familiarize with physical and virtual memory management techniques
4. Describe UNIX kernel, data structures and internal representation of files in UNIX operating system
5. Illustrate Inter process communication mechanisms</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Explain the history, basics and structure of operating systems
2. Implement various process management and scheduling schemes
3. Design and develop memory management techniques
4. Demonstrate the internals of UNIX operating system
5. Use the computing environment and various services of operating system for development of applications.</td></tr>
</table>

COURSE CONTENTS

Unit 1: Operating System Principles **[14hrs]**

Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating Systeminterface, System calls and system programs, Operating System structure, Virtual machines.

Unit 2: Process Management **[12hrs]**

Process concept, process scheduling, Operations on processes, Inter process communication. Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, Scheduling algorithms, Multiple Processor scheduling Thread scheduling.

Unit 3: Memory Management **[12hrs]**

Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Unit 4: UNIX kernel and its file **[12hrs]**

Introduction to Kernel: Architecture of the UNIX operating system, Introduction to system concepts, Kernel data structures, System Administration, Internal representation of Files: Inodes, structure of a regular file, Directories, Conversion of a path Name to an Inode, Super block,Inode assignment to a new file, Allocation of disk blocks, other file types.

Text Books:

1. Abraham Silberschatz, Peter Bear Galvin, Greg Gagne, 'Operating System Principles', Wiley Asia Student Edition 2009.
2. William Stallings, 'Operating Systems: Internals and Design Principles', Prentice Hall of India, seventh edition 2011.
3. Maurice J. Bach, 'The Design of the UNIX Operating System', Pearson Education; Prentice Hall of India, 2004.

Reference Books:

1. D. M. Dhamdhere, 'Operating Systems: A Concept-Based Approach,' Tata McGraw Hill, 2002.
2. Charles Crowley, 'Operating System: A Design-oriented Approach', Irwin Publishing, 2002.
3. Gary J. Nutt; 'Operating Systems: A Modern Perspective', Addison-Wesley, 2011.
4. Springer transaction for advance in Distributed computing and middleware.
5. IEEE transaction for Real time operating system.
6. ACM transaction for embedded operating system

<table>
<tr><td>Sub Code: BTEE15F7501</td><td rowspan="2">Testing and Commissioning of Electrical Equipment</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To enable students to understand the standard specifications of various electrical equipment as per BIS(Bureau of Indian Standard)
2. To enable the students to understand standard tests forinstallation of various electrical equipment as per BIS(Bureau of Indian Standard)
3. To enable the students to understand standard commissioning tests various electrical equipment as per BIS(Bureau of Indian Standard)
4. To enable the students to understand standard performance tests of various electrical equipment as per BIS(Bureau of Indian Standard)</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:</td></tr>
</table>

	1. Be able to describe the standard specifications of various electrical equipment. 2. Be able to describe the standard tests, specifications for installation of various electrical equipment 3. Be able to describe the commissioning tests on various equipment 4. Be able to describe the performance tests on various equipment

COURSE CONTENTS

Unit 1: Transformers **[12hrs]**

Specifications: Power and distribution transformers as per BIS standards.

Installation: Location, site, selection, foundation details (like bolts size, their number, etc.), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings andgeneral inspection.

Commissioning tests: Following tests as per national & International Standards, volt ratio test, earth resistance, oil strength, Bucholz & other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test.

Specific Tests: Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal &abnormal conditions.

Unit 2: Synchronous Machines **[12hrs]**

Specifications: As per BIS standards.

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out. 2 hours

Commissioning Tests: Insulation, Resistance measurement of armature & field windings, waveform & telephone interference tests, line charging capacitance

Performance tests: Various tests to estimate the performance of generator operations, slip test, maximum lagging current, maximum reluctance power tests, sudden short circuit tests, transient & sub transient parameters, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests.

Factory tests: Gap length, magnetic eccentricity, balancing vibrations, bearing performance

Unit 3: Induction Motors **[13hrs]**

Specifications: for different types of motors, Duty, I.P. protection.

Installation: Location of the motors (including the foundation details) & its control apparatus, shaft & alignment for various coupling, fitting of pulleys & coupling, drying of windings.

Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations & balancing. 5 Hours Electrical Tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test, factory test and site test (in accordance with ISI code)

Specific Tests: Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

Unit 4: Switch Gear & Protective Devices **[8hrs]**

Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests.

Text Books:

1. S. Rao, ‘Testing & Commissioning Of Electrical Equipment’,
2. B .V. S. Rao, ‘Testing & Commissioning Of Electrical Equipment’

Reference Books:

1. Relevant Bureau of Indian Standards
2. H. N. S. Gowda, ‘A Handbook on Operation and Maintenance of Transformers’
3. Transformer & Switch Gear Handbook -Transformers-BHEL, J &P, J & P

Sub Code: BTEE15F7502	**Electricity Regulations**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the Indian Electricity rules 1956. 2. To understand the provisions provided in Indian Electricity Act 2003. 3. To highlight about the Electricity scenario in India 4. To provide the first hand information and knowledge on KERC & CERC guidelines for power generation, transmission and distribution					
Course Outcomes	On completion of this course the students will be able to:					

	1. Apply the electricity rules 1956 for electrical equipment and also power systems. 2. Apply the provisions given in Electricity act 2003 in Electrical power generation, transmission and distribution system. 3. Adopt the norms given by KERC and CERC for power system. 4. Gain knowledge on open access, power trading, power wheeling, power banking and ABT.

COURSE CONTENTS

Unit 1: **[14hrs]**

Overview of Power Sector: Electricity Scenario at National Level and State Level with Key Statistics relating to Generation, Transmission and Distribution of power.

Organizational Set up and Introduction to Electricity Laws – A brief discussion on functional set up of power sector at national and state level and connectivity among different statutory entities and introduction to EA 2003, EC 2001 and KER Act 1999.

Over View of Regulations Governing Electricity Generation and Transmission – A brief description of Key regulations issued by CERC and KERC on Generation and Transmission activity.

Over View of Regulations Governing Distribution & Trading - A brief description of key regulations issued by CERC and KERC on Distribution and Trading activity.

Unit 2: **[14hrs]**

Provisions relating to Electricity Generation in Act 2003 and related case studies Sl. No. 7, 8, 9, 10 & 11 of Electricity ACT 2003.

Provisions relating to Grid Operation in Act 2003 and related case Studies Sl. No. 25, 26,27,28, 29, 30, 31, 32, 33 & 34 of Electricity ACT 2003

Provision of Power generation by Distributed generations (DG) and interconnection with grid norms from Central Electricity Authority Grid code 2010

Unit 3: **[14hrs]**

Provisions Relating to Electricity Transmission and related cases Sl. No. 38, 39, 40 & 41 of Electricity ACT 2003

Provisions Relating to Electricity Distribution in Act 2003 and related case studies Sl. No. 42, 43, 55, 56 & 135 of Electricity ACT 2003

Key Technical Aspects relating to supply of electricity and supply code

Unit 4: **[14hrs]**

Safety in Supply of Electricity - Regulations and Case studies - Safety Regulations issued by CEA.

Electricity Trading and Power Business Trading Regulations issued by CERC and KERC, & Case Studies

Electricity Tariffs – Provisions in the Act, related regulations and case studies Sl. No. 61, 62, 63, 64 & 65 of Electricity Act 2003, Open excess, wheeling & banking of power, Availability Based Tariff (ABT)

Text Books:

1. Electricity Act 2003, Kamal Publishers; 2017 edition (2017).
2. The Electricity Rules, 2005 & the Indian Electricity Rules, 1956 (Latest Bare Act),
3. Central Electricity Authority Grid code 2010, http://www.cea.nic.in/reports/regulation/tech_std_reg.pdf.
4. Website http://bescom.org/en/wheeling-bankingopen-access/
5. Website http://www.forumofregulators.gov.in/Data/study/STUDY_ON_ANALYSIS_OF_TARIFF_ORDERS&OTHER_ORDERS_OF_STATE_ELECTRICITY_REGULATORY_COMMISSIONS.pdf

Sub Code: BTEE15F7503	**Non-Conventional Energy Sources**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To analyze the environmental and cost economics of using renewable energy sources compared to fossil fuels. 2. To understand the solar geometry required to estimate the solar radiation. 3. To estimate maximum power available in wind. 4. To introduce various renewable energy conversion technologies like Biomass, Geothermal, Ocean energy. 5. To introduce Magnetohydrodynamic system and energy storage					

	systems
Course Outcomes	On completion of this course the students will be able to: 1. Select the appropriate renewable energy as an alternate for conventional power in any application. 2. Design solar PV module for any given application. 3. Deduce maximum power available in any given location. 4. Acquire the knowledge of modern energy conversion technologies. 5. Understand characteristics of the storage systems

COURSE CONTENTS

Unit 1: **[12hrs]**

Introduction: Energy Sources and their availability, renewable energy sources, Prospects of renewable energy sources.

Energy Scenario: Energy needs of India – Energy consumption patterns – Worldwide Potentials of these sources – Energy efficiency – Energy security – Energy and its environmental impacts – Global environmental concern – Kyoto Protocol.

Unit 2: **[12hrs]**

Solar Energy: Introduction, Solar Constant, Basic Sun-Earth Angles – definitions and their representation, Solar Radiation Geometry (numerical problems), Estimation of Solar Radiation of Horizontal and Tilted Surfaces (numerical problems);

Solar thermal Systems – Types of collectors – Collection systems – Applications – Photo Voltaic (PV) technology – Solar cells – Cell technologies – Characteristics of PV systems – Equivalent circuit – Building integrated PV system and its components – Sizing and economics – Peak power operation – Standalone and grid interactive systems.

Wind Energy: Energy available from wind, General formula, Lift and drag. Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, Advantages and Disadvantages of WECS.

Unit 3: **[12hrs]**

Bio Mass Energy: Biomass conversion technologies bio mass generation, classification of Bio Gas Plants, Factors affecting Biogas generation, Biomass program in India.

Geothermal Energy: Sources of Geothermal energy Estimation of Geothermal Power, Geothermal Power Plants, Geothermal energy in India and Prospects.

Ocean Energy: Ocean thermal energy conversion(OTEC), Principle of OTEC system, Methods of OTEC power generation, site selection, Prospects of ocean energy in India, – Principle of Tidal Power, Tidal Power Plant, Prospects in India.

Unit 4: **[12hrs]**

MHD & Hydrogen Energy: Basic Principle of MHD (magnetohydrodynamic) system, advantages, Power OUTPUT of MHD Generation, future Prospects. Principle and classification of fuel cell energy, hydrogen as alternative fuel for Generation of Electrical Energy & applications.

Energy Storage: Battery – Types – Equivalent circuit – Performance characteristics – Battery design – Charging and charge regulators – Battery management – Fly wheel energy relations – Components – Benefits over battery – Storage systems – Ultra capacitors.

Text Books :

1. Rai, G. D., 'Non-Conventional Energy Sources', Khanna Publishers, 5th edition.
2. D.P Kothari, K.C.Singla, Rakesh Ranjan, 'Renewable Energy Sources and Emerging Technologies', PHI Publications.
3. Bansal Keemann, Meliss, 'Renewable energy sources and conversion technology', Tata McGraw Hill.

Reference Books:

1. Mittal, 'Non-conventional Energy Systems', Wheelers Publication.
2. Ramesh R & Kumar K U, 'Renewable Energy Technologies', Narosa Publishing House

Sub Code: **BTEE15F7504**	**Fuzzy Logic Control Systems**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**

Course Objectives:

1. To enable students to know the principle of fuzzy logic control.
2. To enable students to describe the formulation of fuzzy logic system.
3. To enable students to understand the multilevel control of fuzzy system
4. To enable students to understand the concept of adaptive fuzzy control system.

Course Contents:

UNIT-I: [14L]

Review of Fuzzy sets, basic operations, advanced operations, Fuzzy relations, extension principles, linguistic variables Fuzzy if-then-rule, Fuzzy logic and approximate reasoning Fuzzy rule base, inference engine, fuzzification and defuzzification, Fuzzy system as non-linear mapping, approximate properties of fuzzy systems.

UNIT-II: [14L]

Design of fuzzy system using table lookup, gradient dissent training, recursive least squares, clustering Fuzzy control of linear systems, SISO system and MIMO systems, optimal and roust control.

UNIT-III: [14L]

Analysis and design of multilevel control, gain scheduling of PID controllers.

UNIT-IV: [14L]

Adaptive fuzzy control, design of indirect, direct and combined adaptive fuzzy controllers Advanced adaptive fuzzy controllers.

Text Books and References:

1. Wang Li-Xin, “A course in Fuzzy system & Control”, Prentice Hall
2. Timothy, J.R., “Fuzzy Logic with Engineering Application” McGraw Hill, 2000.
3. Hung T Nguyen and elbert A Walker, “A first course in Fuzzy logic:, CRC press 3rd Edition

Course Outcomes:

On completion of this course the students will be able to:

1. Know the concept of fuzzy system
2. Form fuzzy rules for a specific application.
3. Apply mathematical concept to formulate fuzzy logic rules
4. Apply fuzzy rules for a buck converter.

Sub Code: BTEE15F7700	**Relay and High Voltage Lab**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Weeks		**2**	**1**	**0**	**1**	**3**
Course Objectives:	1. To make the students gain the knowledge of operation of over current, under voltage relays. 2. To measure HVAC and HVDC using spheres. 3. To analyze the characteristics of fuse.					
Course outcomes	At the end of this course, Student will be able to: 1. Develop skills to measure HVAC and HVDC parameters. 2. To understand the operation of different relays					

List of Lab Experiments:

1. Determination of current time characteristics of electro mechanical over current relay.
2. Determination of current time characteristics of Microcontroller based over current relay.
3. Determination of operating characteristics of Microcontroller based Under voltage relay.
4. Observing the operation of Motor protection Relay for various faults.
5. Observing the operation of Negative Sequence Relay.
6. To draw operating characteristics of fuse under constant current and constant length conditions.
7. Determination of break down strength of liquid dielectric.
8. Measurement of HVAC using standard spheres.
9. Measurement of HVDC using standard spheres.
10. Measurement of HVAC for different electrode configurations.
11. Field mapping using Electrolytic tank for capacitor model

Sub Code: BTEE157800	**Power System Simulation Laboratory**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Weeks		**2**	**1**	**0**	**1**	**3**
Course Objectives:	1. To enable the students gain a fair knowledge on the programming and simulation of Power Electronics and Power Systems					
Course outcomes	At the end of this course, Student will be able to: 1. Acquire skills of using computer packages MATLAB coding					

	and SIMULINK in power electronics and power system studies. 2. Acquire skills of using ETAP software for power system studies

List of Lab Experiments:

1. Formation of Z bus (without Mutual coupling) using Z bus building Algorithms.
2. Y bus formation for power systems with & without mutual coupling, by singular transformation and inspection method.
3. Determination of bus currents , bus power and line flow for a specified system voltage(Bus) profile.
4. ABCD Parameters: Formation for symmetric π/T configuration. Verfication of AD- BC = 1, Determine the efficiency and regulation.
5. Determination of power angle diagrams, reluctance power, excitation emf and regulation for salient and non salient pole synchronous machines.
6. Formation of Jacobian for a system not exceeding 4 buses (no PV buses) in polar co ordinates.
7. To determine faults currents and voltages in single transmission line system with star- delta transformers at a specified location for LG, LLG.
8. Load flow analysis using Gauss Siedel method and N-R method for both PQ & PV buses.
9. Optimal generation scheduling for thermal power plants.

Note: 1. Experiments: 1 to 6: Simulation experiments using MATLAB/ C/ C++
2. Experiments: 7 to 9: Use Suitable standard software Package

VIII Semester

SL	Course Code	Title of the Course	HC/ SC/ OE	C	L	T	P	CH
1	BTEE15F8100	Project Phase II	HC	8	0	1	7	16
2	BTEE15F8201	Operation and Control of Power Systems	SC	4	3	1	0	5
	BTEE15F8202	Introduction to Flexible AC transmission system						
	BTEE15F8203	Estimation and Design of Electrical Installation						
	BTEE15F8204	Artificial Neural Network						
3	BTEE15F8301	Electrical Power Quality	SC	4	3	1	0	5
	BTEE15F8302	Electrical Distribution system						
	BTEE15F8303	Electrical Safety						
4	BTEE15F8401	Management & Entrepreneurship	SC	4	3	1	0	5
	BTEE15F8402	Electrical Energy Conservation						
	BTEE15F8403	Computer Control of Electric drives						
	BTEE15F8404	Trouble Shooting of Common Electrical Appliances						
TOTAL CREDITS				**20**	**9**	**4**	**7**	**31**

Sub Code: BTEE15F8100	**Project Phase - II**	**C**	**L**	**T**	**P**	**CH**
Duration :14 Weeks		**8**	**0**	**1**	**7**	**16**
Course Objectives:	1. Identify and practice research ethics and responsible to conduct in research 2. To know and apply problem solving skills to constructively address research setbacks 3. To work collaboratively with other researchers, using listening and communication skills 4. To work autonomously in an effective manner and setting and meeting deadlines 5. To reflect on their own research, identifying lessons learned, strengths, and ways to improve 6. To communicate confidently and constructively withfellow graduate students and faculty as mentors 7. To explain their research to others in the field and to broader audiences through research presentations 8. To articulate the relevance of their research to their coursework and professional future, synthesizing their research, academic, and professional interests and goals 9. To identify and describe what they could expect as a					

	graduate student 10. To reflect constructively on their research experience in making decisions about their future.
Course outcomes	At the end of this course, Student will be able to: 1. Apply relevant knowledge and skills, within the main area, to a given problem - within given constraints, 2. Analyze and discuss complex inquiries/problems and handle larger problems independently even with limited information 3. Evaluate and critically assess one's own and others' scientific results 4. Document and present one's work with strict requirements on structure, format, and language usage 5. Identify one's need for further knowledge and continuously develop one's own knowledge

GUIDELINES

Guidelines for the preparation of the Report: As per the University Guidelines

Guidelines for the Evaluation:

1. Student has to submit a progress report -I and give the presentation during C1 which carries 20% of the total marks
2. Students has to submit a progress report -II and give the presentation of the project work during C2, which carries 20% of the total marks
3. Students has to submit the Project Thesis and need to give a presentation of the project work and face Viva-Voce during C3, which carries 60% of the total marks
4. All the above reports must undergo a plagiarism check which should not exceed 25% and failing which lead to resubmission

Sub Code: BTEE158201	**Operation and Control of Power Systems**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To provide students the knowledge of Economic Load Dispatch used in the power system and Load Frequency Control (LFC). 2. To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models. 3. To provide the knowledge of hydrothermal scheduling, Unit					

	Commitment problem. 4. To provide the knowledge of SCADA and the concepts of Deregulation
Course Outcomes	On completion of this course the students will be able to: 1. To make students understand Economic operation of power system and importance of LFC control. 2. To allow students discuss about thermal and hydro power plants operation in meeting the load demand optimally. (State and central wide installation). 3. To improve student's ability in solving problems (numerical problems at present) by posing different problem models related to Economic Load Dispatch, Load Frequency Control. 4. Apply their knowledge in PSOC for competitive exams like GATE, IES, and Public sector etc. 5. Ability to discuss single area load frequency control and two area load frequency control. 6. Ability to model and design turbine and Automatic controller. 7. Ability to express variation of frequency in the power system with varying load

COURSE CONTENTS

Unit 1: Automatic Load Frequency Control: [12hrs]

Basic generator control loops, Exciter types, Exciter modeling, Generator modeling. Automatic Load frequency control of single area systems, Speed governing system, Turbine generator response, Static and dynamic performance of speed governor, Closing of ALFC loop, Concept of control area, Static response of primary ALFC loop, Integral control, ALFC of multi-control area systems (POOL operation), The Two-Area system, Modeling the Tie-Line, Block Diagram representation of Two-Area system, Static response of Two-Area system and Tie-Line Bias control.

Unit 2: Optimal System Operation and Unit Commitment: [10hrs]

Introduction , Optimal operation of generators on a bus bar, Statement of the Unit Commitment problem, need and importance of unit commitment, Constraint in Unit Commitment, Unit Commitment solution methods-Priority lists method, Forward Dynamic Programming method(excluding problem), Spinning reserve.

Unit 3: Economic Operation of Power Systems [10hrs]

Introduction, Performance curves, Economic generation scheduling neglecting losses and generator limits, Economic generation scheduling including generator limits and neglectinglosses; Iterative techniques; Economic Dispatch including transmission losses – approximate penalty factor, iterative technique for solution of economic dispatch with losses; Derivation of transmission loss formula; Optimal scheduling for Hydrothermal plants – problem formulation, solution procedure and algorithm.

Unit 4: SCADA and Power System De-Regulation [10hrs]

Introduction- SCADA, Motivation for restructuring of power systems- Electricity market entities model benefits of deregulation- Terminology-Deregulation in Indian power sector-Operations in power markets-Power pools-Transmission networks and electricity markets

Text Books:

1. Nagrath, I. J., and Kothari, D. P, 'Modern Power System Analysis', TMH, 3rd Edition, 2003.
2. A.J.Wood & B.F.Woollenberg, 'Operation and Control', John Wiley Power Generation, 2nd edition.

Reference Books:

1. P.Venkatesh. B.V.Manikandan, S.Charles Raja, A.Srinivasan, 'Electrical power systems: Analysis, security, Deregulation', PHI 2012.
2. A. Chakravarthi and S. Halder, 'Power System Analysis Operation and Control ', PHI, 3rd Edition.
3. O I Elgerd, 'Electric Energy Systems', Mc Graw-hill.

Sub Code: BTEE15F8202	**Introduction to Flexible AC Transmission Systems**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To emphasis the need for FACTS controllers. 2. To review the static devices for series and shunt control. 3. To study the operation of controllers for enhancing the transmission capability					
Course Outcomes	On completion of this course the students will be able to: 1. Describe the need of flexible AC transmission and the associated problems. 2. Describe the characteristics, applications and modelling of series and shunt FACTS controllers. 3. Analyze the interaction of different FACTS controller with the power system					

COURSE CONTENTS

Unit 1: AC Transmission Line and Reactive Power Compensation [8hrs]

Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration of a transmission interconnection, relative importance of controllable parameters, basic types of FACTs controllers, shunt, series, combined shunt and series connected controller

Unit 2: Voltage Sourced Converters **[12hrs]**

Power semiconductor devices: types of high power devices, principle of high power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT).

Voltage sourced converters: Basic concepts, single-phase full wave bridge converter operation, and square wave voltage harmonics for a single-phase bridge 3-phase full wave converters.

Unit 3: Static Series Compensators **[8hrs]**

GCSC, TSSC, TCSC and SSSC, objectives of series compensation, variables impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators.

Unit4: Self and Line Commutated Current Source Converter **[12hrs]**

Basic concepts, 3 phase full wave rectifier, thyristor based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter.

STATIC SHUNT COMPENSATORS SVC AND STATCOM: Objective of shunt compensation, methods of controllable Var generation, Static Var Compensator (SVC) and STATCOM, comparison between SVC and STATCOM.

Text Books:

1. N.G.Hungorian & Laszlo gyugyi, 'Understanding Facts - Concepts and technology of flexible AC Transmission system', IEEE Press, standard publisher, 2001.

Reference Books:

1. S.Rao, 'EHV - AC, HYDC Transmission & Distribution Engineering', Khanna publishers, 3rd edition 2003.
2. K.R. Padiyar, 'FACTS - Controllers in Power Transmission distribution', New age publishers, 2007.

Sub Code: BTEE15F8203	**Estimation and Design of Electrical Installations**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To enable students to describe the standard specifications of					

	various electrical components for wiring 2. To enable students to describe the standard tests, specifications for installation of various electrical installation. 3. To enable students to design simple residential ,commercial and power installation ,overhead lines, transmission lines , substations 4. To enable students to estimate material required for simple residential ,commercial and power installation ,overhead lines, transmission lines , indoor and outdoor substations
Course Outcomes	On completion of this course the students will be able to: 1. Be able to describe the standard specifications of various electrical components for wiring 2. Be able to describe the standard tests, specifications for installation of various electrical installation 3. Be able to design simple residential ,commercial and power installation ,overhead lines, transmission lines , substations 4. Be able to estimate material required for simple residential ,commercial and power installation ,overhead lines, transmission lines , indoor and outdoor substation

COURSE CONTENTS

Unit 1: Introduction to estimation & costing **[4Hrs]**

Introduction to estimation & costing, Electrical Schedule, Catalogues Market Survey and source selection, Recording of estimates, Determination of required quantity of material ,Labor conditions, Determination of cost material and labor, Contingencies ,Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills , Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules

General rules guidelines for wiring of residential installation **[6Hrs]**

Positioning of equipments, Principles of circuit design in lighting and power circuits Procedures for designing the circuits and deciding the number of circuits, Load calculations and selection of size of conductor, Selection of rating of main switch, distribution board, protective switchgear ELCB and MCB and wiring accessories Method of drawing single line diagram, Selection oftype of wiring Rating of wires and cables Earthling of residential Installation Sequence to be followed for preparing estimate, Preparation of detailed estimates of materials of residential installation

Unit 2: Service connection, Inspection & Testing of Installation **[4hrs]**

Concept of service connection, Types of service connection and their features, Method of installation of service connection, Estimates of under ground and overhead service connections Inspection of internal wiring installations, Inspection of new installations,Testing of installations, Testing of wiring installations ,Reason for excess recording of energy consumption by energy meter

Electrical installation for power circuits: **[6hrs]**

Introduction, important considerations regarding motor installation wiring Determination of input power, Determination of input current to motors, Determination of rating of cables, determination of rating of fuse, Determination of size of Condit, distribution Board, Main switch and starter , Detailed steps for problem

Unit 4: Design & Material Estimation of over head Transmission and Distribution lines **[12hrs]**

Introduction, Typical AC electrical power system, Main components of overhead lines. line supports, Factors governing height of pole, Conductor materials ,Determination of size of conductor for overhead transmission line, Cross arms, Pole brackets and clamps, Guys and Stays, Conductors configuration spacing and clearances, Span lengths, Overhead line insulators, Insulator materials, Types of insulators, Lightning Arrestors, Phase plates, Danger plates, Anti climbing devices, Bird guards, Beads of jumpers, Muffs, Points to be considered at the time of erection of overhead lines..Erection of supports, Setting of stays, Fixing of cross arms, Fixing of insulators, Conductor erection. Repairing and jointing of conductor, Dead end clamps, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs. Earthing of transmission lines, Guarding of overhead lines, Clearances of conductor from ground, Spacing between conductors .Testing and commissioning of overhead distribution lines, Some important specifications. Design procedure for 11kV destitution(HT line) .Components used in over head transmission line. Specification of materials used in transmission line. Design procedure for transmission line

Unit 4: Design & estimation of substation **[8hrs]**

Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram Key diagram of typical substations . Equipment for substation and switchgear installations, Substation auxiliaries supply, Substation Earthing. Design procedure and numerical

Text Books:

1. J.B. Gupta, 'Electrical Installation Estimating & Costing', VIII Edition, S.K. Katria & Sons New Delhi

Reference Books:

1. K.B.Raina S.K.Bhattacharya, 'Electrical Design Estimating and Costing', New Age International.
2. Uppal, 'Electrical Wiring Estimating and Costing', Khanna Publishers Delhi
3. I.E.Rules and Act Manuals

Sub Code:BTEE15F8204	**Artificial Neural Network**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**2**	**0**	**5**
Course Objectives	1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling 2. Provide knowledge of supervised learning in neural networks 3. Provide knowledge of computation and dynamical systems using neural networks 4. Provide knowledge of reinforcement learning using neural networks. 5. Provide knowledge of unsupervised learning using neural networks. 6. Provide hands-on experience in selected applications					
Course Outcomes	1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling. 2. Understand Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory 3. Competitive learning, Self-organizing feature maps 4. Understand the concepts and techniques of neural networks through the study of the most important neural network models.					

	5. Gain knowledge of sufficient theoretical background to be able to reason about the behavior of neural networks. 6. Evaluate whether neural networks are appropriate to a particular application. 7. Apply neural networks to particular applications, and to know what steps to take to improve the performance.

COURSE CONTENTS

UNIT – I **[14 hr]**

Introduction : AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Searching : Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Greedy best first search, A* search Game Playing: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.

UNIT – II **[14 hr]**

Knowledge Representation & Reasons logical Agents, Knowledge – Based Agents, the Wumpus world, logic, propositional logic, Resolution patterns in promotional logic, Resolution, Forward & Backward. Chaining.

First order logic. Inference in first order logic, propositional Vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution.

UNIT – III **[14 hr]**

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units.

Feed forward Neural Networks: Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of pattern storage Networks. Analysis of Pattern Mapping Networks.

UNIT – IV **[14 hr]**

Feedback Neural Networks Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks.

Competitive Learning Neural Networks & Complex pattern Recognition Introduction, Analysis of Pattern Clustering Networks, Analysis of Feature Mapping Networks, Associative Memory.

Text books:

1. Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education.
2. Artificial Neural Networks B. Yagna Narayana, PHI

References:

1. Artificial Intelligence, 2nd Edition, E.Rich and K.Knight (TMH).
2. Artificial Intelligence and Expert Systems – Patterson PHI.
3. Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.
4. PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education
5. Neural Networks Simon Haykin PHI
6. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition.

<table>
<tr><td>Sub Code: BTEE15F8301</td><td rowspan="2">Electrical Power Quality</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To provide basic concepts about power quality issues like voltage variation and frequency variation in electrical distribution system.
2. To provide basic concepts about linear and non-linear loads and their effects on power quality.
3. To enable students to study the effects of power quality issues on performance of end-use equipments and distribution equipments like transformers, conductors, breakers, etc.
4. To expose students to the various techniques of alleviating power quality problems.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:

1. Differentiate between linear and non-linear loads and their effects on power distribution system.
2. Take remedial measures against voltage flickers, harmonics and other power quality related issues so as to ensure safe operating conditions for equipment.
3. Interpret various international standards for control of harmonics, develop skills in measurement of harmonics and be aware of custom power devices for harmonic suppression.
4. Model an electrical industrial distribution system, carryout systematic harmonic analysis and design filters to suppress harmonics so as to comply with industrial standards.</td></tr>
</table>

Unit 1: Power quality and voltage variation**:** **[14 hr]**

Power quality general: Introduction, linear loads, non-linear loads, power quality evaluation procedures term and definitions: general classes of power quality problems, transients, long duration voltage variation, short duration voltage variations, voltage imbalance, waveform distortion, power quality terms.

Voltage variation and transients: Sources of sags, swells and interruptions, estimating voltage sag performance, fundamental principles of protection, motor starting voltage sag. Sources of transient over voltages, impulse transients, oscillatory transients, voltage flicker, principles of over voltages protection, utility capacitor switching transients,

Unit 2: Harmonics **[14 hr]**

Fundamentals of harmonics: Harmonic distortion, harmonic sequences, harmonic indexes, harmonic sources from commercial loads, harmonic sources from Industrial loads, effects of harmonic distortion, interharmonics. Harmonic distortion evaluations, principles for controlling harmonics, harmonic studies, devices for controlling harmonic distortion, harmonic filters, standards of harmonics

Unit 3: Harmonic measurement, standard and bench marking **[14 hr]**

IEEE and IEC standards for measurement of harmonics, measurement of electrical parameters using rms meters and true rms meters, current and voltage total harmonic distortion, individual current and voltage harmonics, Current & voltage harmonic limits, power quality measurement equipments.

Power quality benchmark: Introduction, benchmark process, power quality contract, power quality state estimation, including power quality in distribution planning.

*Distributed generation***:** DG technologies, interface to utility system, power quality issues, interconnection standards.

Unit 4: Custom power devices and power quality monitoring **[14 hr]**

Principle and operation of custom power devices like DSTATCOM, Dynamic voltage restorer (DVR) & unified power quality conditioners (UPQC) to suppress power quality issues. Monitoring considerations, assessment of power quality measurement data, application of intelligent systems, power quality monitoring standards.

Text Books and References:

1. Electric Power Quality, Roger C. Dugan, Surya Santoso, Mark F. McGranaghan and H. Wayne Beaty, McGraw-Hill professional publication, 2nd edition, 2003.
2. Power Quality in Electrical Systems, Alexander Kusko and Marc T. Thompson, McGraw-Hill Companies, Inc., 2007.
3. Power Quality, C. Sankaran, CRC Press LLC, 2002.

4. Power quality enhancement using custom power devices, Arindam Ghosh and Gerard Ledwich, Kluwer Academic Publishers, 2002.
5. Power quality problems and mitigation techniques, Bhim Singh, Ambrish Chandra and Kamal Al-Haddad, Johny Wiley & Sons, Inc., 2014.
6. Electric Power Quality, G.T. Heydt, stars in a circle publications, 1991.
7. Modern Power Electronics, M.H. Rashid, TATA McGraw Hill, 2002.
8. Understanding power quality problems voltage sags and interruptions, Math H. J. Bollen, IEEE Press, 2000
9. Power quality in power systems and electrical machines, Ewald F Fuchs, A.S. Mohammad and Masoum, Academic Press, Elsevier, 2009.
10. IEEE papers on power quality

<table>
<tr><td>Sub Code: BTEE15F8302</td><td rowspan="2">Electrical Distribution System</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To give an overview of the function of an electrical power distribution in an electric power system.
2. To have the wider knowledge on planning and design of a distribution infrastructure</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Describe the design of distribution system.
2. Analyze the different types of network.
3. Describe the optimization techniques involved in the planning of distribution system</td></tr>
</table>

COURSE CONTENTS

Unit 1: Distribution System Planning and Design **[10hrs]**

Introduction, Factors affecting system planning, present planning techniques, planning models, Sub-transmission and substation design. Sub-transmission networks configurations, Substation bus schemes, Distribution substations ratings, Service areas calculations, and Substation application curves, future trends in planning, systems approach, and Distribution automation.

Unit 2: Distribution System Automation **[10hrs]**

Distribution Automation: Control functions– Communication system –Consumer Information Service– Geographical Information Systems. SCADA –block diagram –functions.
Energy Management: Supply Side Management–Demand Side Management–Technologies Implementation, Dispersed Generation.

Unit 3: System Planning **[10hrs]**

Planning process, planning criteria, system developers, dispersed generation, distribution systems, economics and finance, mapping. Load Characteristics - Basic definition, relationbetween load and load factor, load growth.

Reliability-Basic reliability concept –Cost verses system Reliability –Reliability planning procedure–Mathematical concept.

Unit4: Optimization **[10hrs]**

Introduction, costing of schemes, typical network configurations, planning terms, network cost modeling, synthesis of optimum line network**.**

Text Books:

1. Turan Gonen, 'Electrical Power Distribution Engineering', Tata McGraw-Hill Publishing company Ltd, 1986.
2. Pabla A S, 'Electrical Power Distribution Systems', 5th Edition, TMH, 2004.
3. Dr. Khedkar M K, Dr. Dhole G M, 'A Textbook of Electric Power Distribution Automation', University Science Press, Delhi, Laxmi Publications, 2010

References:

1. LucesM. Faulkenberry, WalterCoffer, 'Electrical Power Distribution and Transmission', Pearson education, 1996, ISBN978-81-317-0709-8.
2. ColinBayliss, 'Transmission and Distribution Engineering', Butterworth Heinemann,1996.
3. KankarBhattacharya, Math H. JBollen, JaapE. Daalder, 'Operation of Restructured Power Systems', Kluwer academic publishers, USA, First Edition, 2001

Sub Code: BTEE15F8303	**Electrical Safety**	**C**	**L**	**T**	**P**	**CH**
Duration: 14 Weeks		**4**	**3**	**1**	**0**	**5**
Course Objectives	1. To understand the importance of electrical safety in work place as well as at dwellings. 2. To provide an overview of information regarding use of safe electrical equipment. 3. To understand the importance of use of safety gadgets, safe practices while working on electrical equipment. 4. To understand and need of protection to avoid electrical hazards. 5. To understand the different electrical safety standards and practice regularly					

Course Outcomes	On completion of this course the students will be able to: 1. Understand the basic electric safety norms. 2. Adopt the best & safe practices while doing electrical work. 3. Understand the various IE rules for safe operation. 4. Understand the importance of earthing and other related safety equipments 5. Use the appropriate electrical gadgets like MCBs, Fuses, ELCB, wire sizes, Switch sizes, etc.

COURSE CONTENTS

Unit 1: General Electric Safety **[13hrs]**

Basic concept of Electric safety, Hazards of electricity, Parameters affecting electric shock intensity and Effects of electricity on human body. Step potential and touch potential. Electrical safety standards like IE Rule 1956 and Electricity Act 2003. National and International Safety codes. Electrical joints & end terminations and temperature variation.

Unit 2: Causes of accidents and best practices [**14hrs]**

Electrical safety work practices, Causes of accidents, Unsafe acts, Best practices, Electrical safety guidelines for transformers, switchgears, motors, lifts, inverters, electrical home appliances, etc.

Unit 3: Earthing **[12hrs]**

Type of earthing, Importance of earthing, Measurement of ground resistance, Soil resistivity, Parameters affecting earthing, Measurement of earth resistance, maintenance of earthing.

Unit 4: Safety Gadgets and safety equipment **[15hrs]**

Safety communications like sign boards, lock out tags, etc., Use of Personal protection Equipments (PPE), Use of Earth Leakage Circuit Breakers (ELCB), Molded circuit breakers (MCBs), Molded case circuit breakers, Different types of fuses, Electrical safety gadgets. Lightning Arrestors, Earth leakage relays.

References:

1. National Electrical Code 2011, Bureau of Indian Standard, 2011.

2. Handbook for Electrical Safety, Cooper Bussmann, Inc., St. Louis, MO 63178-4460, http://www.bussmann.com
3. Electrical Workers' Safety Handbook, e-contractors
4. www.ibew38.org/pdf/safety_handbook.pdf.
5. The safe use of Electricity in the home, www.esb.ie/esbnetworks

<table>
<tr><td>Sub Code: BTEE15F8401</td><td rowspan="2">Management and Entrepreneurship</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To explain the basic concepts, principles, and processes of management.
2. To use the elements of effective decision making–research, assessment and consequence.
3. To develop the abilities to plan for effective communication – learn how to reflect, present and evaluate communication.
4. To Analyse organizational practices that facilitate creativity and innovation
5. To Integrate functional areas into strategic business problems from a general management perspective
6. To develop an ability to work with moral and ethical dilemmas and make decisions using critical thinking</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Integrate management concepts in a technical and innovative setting as required by today's dynamic business environment
2. Possess relevant skills preparing students for entry into management careers in business, government, public, or social service organizations
3. Analyse a business case, propose a creditable solution to a business problem and support your decision with strong arguments.
4. Propose his/her own business ideas and present it to a relevant audience.
5. Apply elements of effective decision making to areas that are central to career development – self assessment, market conditions and planning.</td></tr>
</table>

COURSE CONTENTS

Unit 1: Introduction to management principles **[10hrs]**

Development of Management Thought-Early Management Approaches-Modern Management Approaches, Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of Management - Management as a Science, Art or Profession, Management & Administration, Levels of Management, Roles of Manager. Communication-meaning and importance-Forms and types of communication

Unit 2: Management Process **[16hrs]**

PLANNING-Nature, importance and purpose of planning process - Objectives - Types of plans (Meaning only), Importance of planning - steps in planning & planning premises - Hierarchy of plans. Decision Making, Organisation- Nature and purpose of organization - Principles of organization -Types of organization, Staffing-Nature and importance of Staffing -Process of Selection & Recruitment (in brief). Meaning and nature of directing - Leadership styles, Coordination- meaning and importance and Techniques of Co – ordination.

Unit 3: Project Preparation **[10hrs]**

The Management for Engineers-Personal Management-Personal Management-Objective setting-Self Appraisal Preparation Of Project-Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Errors of Project Report; Project Appraisal.

Unit 4: Entrepreneurship **[16hrs]**

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur. Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers,.

Small Scale Industry- Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start an SSI - Government policy towards SSI;Different Policies of S.S.I.; Government Support for S.S.I. during 5 year plans, Impact of Liberalization, Privatization, Globalization on S.S.I., Effect of WTO/GATT Supporting Agencies of Government for S.S.I. Meaning

Text books:

1. P. C. Tripathi, P. N. Reddy 'Principles of Management', Tata McGraw Hill, 4th Edition, 2010.
2. Vasant Desai, 'Dynamics of Entrepreneurial Development & Management', Himalaya Publishing House.
3. Poornima M Charantimath, 'Entrepreneurship Development - Small Business Enterprises', Pearson Education, 2006.

Reference Books:

1. Robert Lusier, 'Management Fundamentals - Concepts, Application, Skill Development' Thomson.
2. S S Khanka - S Chand & Co, 'Entrepreneurship Development'.
3. Stephen Robbins, 'Management', Pearson Education /PHI -17th Edition, 2003

Sub Code: BTEE15F8402	Electrical Energy Conservation	C	L	T	P	CH
Duration: 14 Weeks		4	3	1	0	5
Course Objectives	1. To understand the present energy scenario of energy generation and to understand the gap between energy supply & demand 2. To make students to understand the need for energy conservation to save the primary fuel for future generation and also to reduce the environmental burden. 3. To provide an overview of various energy conservation opportunities for electrical equipment. 4. To study the importance of energy conservation for reduction of environmental burden. 5. To understand the importance of energy security and energy growth by implementation of energy conservation measures					
Course Outcomes	On completion of this course the students will be able to: 1. Understand the energy losses in different equipment and control the losses 2. Develop capability in measurement and analysis of data to conserve energy. 3. Conduct performance test on electrical equipment and calculate the energy efficiency of equipment. 4. Develop the awareness on controlling of environmental pollution through implementing energy conservation measures. 5. Become an energy auditor and conduct energy audit					

COURSE CONTENTS

Unit 1: Energy management **[8hrs]**

Energy sources, Types of Energy generation systems, Primary fuel and secondary fuel, Gap between energy supply and demand, Energy Conservation Act 2001, Energy audit, Types of energy audits, Preliminary energy audit, Detailed energy audit, Instruments used for energy audit, Energy conservation opportunities, Classification of energy conservation measures, Energy economic feasibility study, simple payback period, time value of money, cash flow, cost to benefit ratio, Reduction of environmental pollution, Energy audit reporting, Star labeling of electrical appliances and problems.

Unit 2: Demand and Power factor management **[6hrs]**

Demand management and Power factor management: Maximum demand, two part tariff, demand controller, concept and application of TOD metering system, smoothening of demand curve, fixed reactive power compensation, automatic reactive power compensation, APFC panels, economics of reactive power compensation and problems

Unit 3: Illumination system **[8hrs]**

Types of lamps used, principle of discharge lamps, performance of fluorescent lamps, compact fluorescent lamps, Lamps efficacy, Colour rendering index (CRI), Installed load efficacy ration (ILER), Types of street lights, Sizing of lighting equipments, Conventional coil wound ballasts, Electronic ballasts, Effect of voltage variation on lighting equipment, illumination level for different applications, LED lighting system and problems.

Unit 4: Electric Equipment **[6hrs]**

Energy conservation in motors: load factor, speed, efficiency, power factor, energy efficient motor, different speed control techniques, variable frequency drives, soft starters, rewinding of motors, and variation of power supply parameters like voltage variation, voltage unbalance and problems.
Energy conservation in transformers: Voltage ratio, loading of transformers, on-load & off load tap changers, power factor on secondary, unbalanced load on secondary, transformer management and problems.
Energy conservation in Air-conditioning system and Air compressors

References:

1. S. Rao and B.B. Parulekar, 'Energy Technology', 4th edition, Khanna Publishers, 2005.
2. Eastop & Croft D.P, 'Energy Efficiency for Engineers and Technologist', Logman Scintific & Technical, ISBN-0-582-03184, 1990.
3. Reay D.A., 'Industrial Energy Conservation', 1st edition, Pergaman Press, 1977.
4. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
5. J.B. Gupta, Generation, transmission and utilization of electric power, Kataria Publication, New Delhi, 1986.

Sub Code:BTEE15F8403	Computer Control of Electric Drives	C	L	T	P	CH
Duration: 14 Weeks		**4**	**3**	**2**	**0**	**5**
Course Objectives	1. To understand the basics of mathematics applied to electrical drives. 2. Understand the basics of magnetic circuits as applicable to the electrical machines. 3. Describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives. 4. To expose the students to various types of power electronic devices and converter circuits including brief analysis and design concepts					
Course Outcomes	On completion of this course the students will be able to: 1. On completion of this course the students will be able to: 2. Understand the concepts and basic operation of electric drive system 3. Understand closed loop operation of dc, induction and synchronous machine drives 4. Understand the design techniques of drive system					

COURSE CONTENTS

Unit 1: Introduction **[10hrs]**

Solid state controlled electric drive-Concept, elements and salient features, power converter motor system, closed loop control of electric drives, sensing of speed and current, review of power converter circuits, performance parameters.

Unit 2: Control of D. C. Drives **[10hrs]**

Starting braking, transient analysis, Control of d.c. separately and series excited motor drives using controlled converters (single phase and three phase) and choppers, multi-quadrant operation of separately excited dc motor fed from fully controlled converter, static Ward- Leonard control scheme, power factor improvement, solid state electric braking scheme, closed loop control schemes.

Unit 3: Control of A. C. Motor Drives **[10hrs]**

Control of three phase induction motor drive using a.c. voltage controllers, cyclo converters. Voltage source and current source inverters; concept of field oriented control, slip power controlled slip ring induction motor drives, closed loop control schemes, self controlled synchronous motor drives, brushless dc motor drive, switched reluctance motor drive.

Unit 4: Microprocessor Control of Electric Drive **[10hrs]**

Functions of microprocessor in electric drive control, salient features of microprocessor control, microprocessor based control schemes for d.c. induction and synchronous motor drives, applications.

Text Books:

1. G. K. Dubey, 'Power Semiconductor controlled Drives', Narosa Publications, 1999
2. J. M. D Mruphy & I. G. Turnbull, 'Power Electronic Control of AC motors', Pergamon Press.

Reference Books:

1. B. K. Bose, 'Power Electronics and ac Drives', Peasrson, 2002
2. S. B. Dewan & G. R. Stemon & A. Straughen, 'Power semiconductor Drives', Wiley Inter Science
3. V. Subrahmanyam, 'Thyristor Control of Electric Motors', Tata McGraw Hill
4. P. C. Sen, 'Thyristor DC Drives', Wiley International
5. S. A. Nasar, 'Electric Machines and Power Systems'.

<table>
<tr><td>Sub Code:
BTEE15F8404</td><td rowspan="2">Trouble Shooting of Common Electrical Appliances</td><td>C</td><td>L</td><td>T</td><td>P</td><td>CH</td></tr>
<tr><td>Duration: 14 Weeks</td><td>4</td><td>3</td><td>1</td><td>0</td><td>5</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. To teach safety rules , important tools used in trouble shooting
2. To teach different types of wires & wire splicing, termination.
3. To teach usage of important electrical meters which are used in the process of trouble shooting.
4. To teach probable faults, causes & remedies on some common electrical equipment.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">On completion of this course the students will be able to:
1. Understand safety rules , important tools used in trouble shooting
2. Understand different types of wires & wire splicing ,
3. Understand the usage of important electrical meters which are used in the process of trouble shooting.
4. Find out faults, causes and remedies for common electrical equipment.</td></tr>
</table>

COURSE CONTENTS

Unit 1: Safety rules & Tools **[12hrs]**

Introduction , safety precautions, safety rules, screw driver , pliers, wire stripper, pocket knife, hammers, chisels, hand & Electric drill, hack saw, Rawlplug tool, neon tester, test lamp, switch board.

Unit 2: Wires, wire splicing and termination **[12hrs]**

Sizes of wires, stranded wires, types of wires, rubber covered, taped, braided, compounded wire, western union splice(joints)

Unit 3: Usage of meters **[12hrs]**

Ammeter, voltmeter, ohm meter (multi meter) megger, earth tester. Earthing.

Case Study on Megger, Earth Tester and Earthing.

Unit 4: Probable Faults, Causes, and remedies on common Electric Equipment's **[12hrs]**

Domestic wiring, two & 3- way control of a lamp, Fluorescence lamp set, Sodium vapor lamp, ,Mixer grinder ,Table fan and ceiling fan ,Electric iron ,3-Phase Induction motor, DOL starter for 3-Phase Induction motor. Control of Domestic motor- pump set.

Text Books:

1. S.L. Uppal, 'Electrical wiring Estimation & costing', Kanna Publications, 5th edition, reprint, 2006
2. Madhvi Gupta, 'Installation, Maintenance & Repair of Electrical Machines & Equipment', Kataria & Sons, 1st Edition, 2014.

Reference Books:

1. Philip Kiameh, 'Electrical equipment Hand book trouble shooting & maintenance', McGraw Hill, Chicago, 2003.

Mapping of Course Outcomes with Program Outcomes

Course Code	PO COs	PO 1	P0 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
BTEM15F1100	CO1	3	3	2	1	1	1						
	CO2	3	3	3	1	1	1						
	CO3	3	3	2	1	1	1						
	CO4	3	3	2	1	2	1						
BTEP15F1200	CO1	3	3	1						1	1	1	1
	CO2	3	3	2						1	1	1	1
	CO3	3	3	2						1	1	1	1
	CO4	3	3	2						1	1	1	1
	CO5	3	3	2						1	1	1	1

BTCV15F1300	CO1	3	3	2	1		2	1				1	3
	CO2	3	3	3	1		1					1	2
	CO3	3	3	2	1		1	1				1	2
	CO4	3	3	1	1		2	1				1	3
BTME15F1400	CO1	3	2					2		2			
	CO2	2	1					2		2			
	CO3	2	2					2		1			
	CO4	3	1					2		2			
BTEE15F1500	CO1	1	2			1	1	1					
	CO2	1	2	1		1	1						
	CO3	1	2	1		1	1	1					
	CO4	1	2	1		1	1	1					1
	CO5	1	3	1		1	1						1
BTIC15F1600	CO1						1	2	2		2		1
	CO2						2	2	2		2		2
	CO3						2	2	3		2		2
	CO4						3	3	3		2		2
BTCE17F1700	CO1									1	3	3	3
	CO2									1	3	3	3
	CO3									1	3	3	3
	CO4									1	3	3	3
BTPL15F1800	CO1	3	3			3					3		
	CO2	3	3			3					3		
	CO3	3	3			3					3		
	CO4	3	3			3					3		

BTEC15F1900	CO1	1	1		1	1							
	CO2	1	1										
	CO3				1	1							
	CO4		1		1								
BTEM15F2100	CO1	3	3	2	1	1	1						
	CO2	3	2	3	1	1	1						
	CO3	3	2	2	3	1	1						
	CO4	3	3	2	1	1	1						
BTEC15F2200	CO1	3	3	3	2	2	1	1					1
	CO2	2	1	1	1	2	1	1				1	1
	CO3	2	3	2	1	2		1				1	1
	CO4	1		1	1	1		1				1	1
BTBE15F2300	CO1	3	1	1	1	1							1
	CO2	1	1	1	2	1							1
	CO3	2		3	2	2							
	CO4	3	1	1	1	1							1
	CO5	1		2		1					1		1
	CO6	1	1	1	2	1							1
	CO7	3	1	1	1	1							1
BTCC15F2400	CO1	3	3	3	2	2							
	CO2	3	2	3	3	3							
	CO3	3	2	3	3	3							
	CO4	3	2	2	3	3							
BTES15F2500	CO1	2		1			2	2		2			1
	CO2	3	1	2	1		3	3		3	1		2

	CO3	1					2	2		2			1
	CO4	3	1	2	2		3	3		3	1		2
	CO5	3	1	2	2		3	3		3	1		2
BTTC17F2600	CO1									1	3	3	3
	CO2									1	3	3	3
	CO3									1	3	3	3
	CO4									1	3	2	2
BTED15F2700	CO1	3	2	2	1	3							
	CO2	3	1	1	1	3							
	CO3	3	3	3	2	3							
	CO4	2	2	2	2	3							
BTCL15F2800	CO1	1	1	1	1		2						1
	CO2	1		1			2	2					1
	CO3	1	1				2	2					1
BTCP15F2900	CO1	3	2	3	2	2							
	CO2	2	1	2	2	2							
	CO3	2	3	3	3	2							
	CO4	3	2	3	2	1							
BTEE15F3100	CO1	3	3	2	1	1	1						
	CO2	3	2	3	2	1	1						
	CO3	3	3	2	1	1	1						
BTEE15F3200	CO1	3	2	1		2							
	CO2	3	3	1		1							
	CO3	1	1	1	1								
	CO4	1	2	3		1							

BTEE15F3300	CO1	1				1	1		1				
	CO2	1	1			1							
	CO3	1	1										
	CO4	1	1										
BTEE15F3400	CO1	3	3	3			1	2	1	2	3		
	CO2	3	3				1						1
	CO3	3	2	1		1			1		2		
	CO4	3				2	1	1		2			
BTEE15F3500	CO1	3	2	1	1	1	1	1					
	CO2	3	3	3	2	2							
	CO3	3	2	3	2	2							1
	CO4	3	1	1	1	3	1						
	CO5	3	3	3	2	2							
BTEE15F3600	CO1	1	3			1	1	1					
	CO2	1	2	2		2	1						
	CO3	1	3	1		1	1	1					
	CO4	1	2	1		1	1	1	1				1
	CO5	1	2	1		1	1	1					
BTEE15F3700	CO1	1		2	1	2					1		
	CO2	2		2	2	1							2
	CO3	1	1	1	1	1							
	CO4	1	1	1	1	1							1
	CO5	1	1	2	2	1							2
	CO6		1	1	1								
	CO7									1	2		

BTEE15F3800	CO1	1	3			1	1	1					
	CO2	1	2	1		1	1						
	CO3	1	3	1		1	1	1					
	CO4	1	2	1		1	1	1					1
	CO5	1	2	1		1	1						
	CO6	1	2	1		1	1						
	CO7	1	3	1		1	1	1					
	CO8	1	2	2		1	1	1					
BTEE15F4100	CO1	3	2	2	1	1	1						
	CO2	3	3	2	2	1	1						
	CO3	3	3	1	1	1	1						
	CO4	3	3	2	1	2	1						
BTEE15F4200	CO1	2	3		1								
	CO2	3	3		1								
	CO3	2	2										
BTEE15F4300	CO1	2	2		3								
	CO2	2	3		2								
	CO3	1	2	2	2								
	CO4	2	2		2								
BTEE15F4400	CO1	3	1	1	1	1							
	CO2	2	1	1	1	1							
	CO3	1	2	1	1	1							
	CO4	1	2	2	2	1							
BTEE15F4500	CO1	3	1	2									
	CO2	3	1	2	1	2							

	CO3	3		3	1	1							2
	CO4	2		3		2							
BTEE15F4600	CO1	2	3	2	2	2	1						
	CO2	2	2	2	2	2	1						
	CO3	2	2	2	2	2	1	1			2		
	CO4	2	1	2	1	1		2					
BTEE15F4700	CO1	1	1										
	CO2		1			2							
	CO3			1		2							
	CO4	1		1		2							
BTEE15F4800	CO1	2	1	3	1	2							
	CO2	1	3	2	2	1							
	CO3	2	2	2	2	1					2		
	CO4	3	3	3	1	1							
BTEE15F5100	CO1	1	1		1								
	CO2	1	1										
	CO3	1			1								
	CO4	1	1										
BTEE15F5200	CO1	3	1					2	3				
	CO2	1	1					2	1				
	CO3	1	2					1	2				
	CO4	2	3					2	2				
	CO5	1	1					2	1				
BTEE15F5300	CO1	2	3	1									
	CO2	3	2		1								

	CO3	2	3	1	1								
	CO4	2	3	1	1	2							
	CO5	2	3	1	1	2							
BTEE15F5400	CO1	3			1								
	CO2	1	2		3	1							
	CO3	3		1	2								
	CO4	1		3	2								
BTEE15F5501	CO1	2	2	1	2	1							
	CO2	2	2	2	2	2	1						
BTEE15F5502	CO1	3	2	2	3	1							
	CO2	2	2	2	3								
	CO3	1	2	2	2	1							2
	CO4	2	2	1	2	1							
BTEE15F5503	CO1	2											
	CO2			1									
	CO3		1	1	1								
	CO4							1					
BTEE15F5504	CO1	3	1						1	3	3	2	2
	CO2	3	3	3	3		3		1	3	3	2	3
	CO3	3	3	2	2	3	2						
	CO4	2	3	1	2	2	1						
BTEE15F5601	CO1	3	2	3	1								
	CO2	3	2	3	1								
BTEE15F5602	CO1	3	3	2	2	1	1						
	CO2	2	2	2	2	2	1						

	CO3	2	2	2	2	2							
	CO4	2	1	1	1	1							
	CO5	1	2	1	2								
BTEE15F5603	CO1	3	2		1	2							
	CO2	2	1		2								
	CO3		2		3	3							
BTEE15F5604	CO1			2	1	3	1	2	1	2		2	3
	CO2				2	3	2	3		1			3
	CO3	1		1		3	1	2		3		2	3
	CO4			1		3		3					3
	CO5					2		2				3	3
BTEE15F5700	CO1	1	1										
	CO2	1		1						1			
	CO3		1		1	1							
	CO4		1		1							1	
BTEE15F5800	CO1	2	1	2		3							
	CO2	2	1	2	1	3							
BTEE15F6100	CO1	1	1		1								
	CO2			1									
	CO3	1			1								
BTEE15F6200	CO1	1		1			1						
	CO2	1		1			1			1			
	CO3		1			1					1		
	CO4		1		1				1			1	
BTEE15F6300	CO1	2	2	2	1								

	CO2	3	3	3	3	1							
	CO3	3	2	2	1	2							
BTEE15F6401	CO1	1			1	1							
	CO2	1		1									
	CO3	1		1	1								
	CO4	1											
BTEE15F6402	CO1	1	3			1	1	1					
	CO1	1	2	2		2	1						
	CO3	1	3	1		1	1	1					
	CO4	1	2	1	1	1	1	1	1				
	CO5	1	2	1		1	1	1	1				1
BTEE15F6403	CO1			3	3	2							
	CO2			3	3	2							
	CO3				3	2						1	
	CO4							2	1				
	CO5	1			2								1
BTEE15F6404	CO1	2	3	3									
	CO2	3	3	2	2	3							
	CO3	3		3	2	3							
	CO4	3		2	3	3	2				3	2	
BTEE15F6501	CO1	1			1								
	CO2		1			1				1			
	CO3		1			1			1				
	CO4	1	1						1			1	
BTEE15F6502	CO1	2	1		1	1							

	CO2	1	3		1	2							
	CO3	2	1		1	1							
	CO4	3	2		1	1							
BTEE15F6503	CO1	1	1					2					
	CO2	1	2					2					
	CO3	1	2	1									
BTEE15F6504	CO1												3
	CO2												3
	CO3											2	3
	CO4											3	3
BTEE15F6601	CO1	1	1	1	1	1	1						
	CO2	1	1	1	1	1	1						
	CO3	2	1	1	1	1							
	CO4	1	1	1	1	1	1	1					
	CO5	1	1	1	1	1							
	CO6	1	1	1	1	1	1	1					
BTEE15F6602	CO1	1	2	3	1								
	CO2	2	3	1	2	1							
	CO3	2	3	1	2	1							
	CO4	1	2	3	3	3							
BTEE15F6603	CO1							1					
	CO2						1		1				
	CO3	2											
	CO4			1				1					
BTEE15F6604	CO1	1	1		3	3		1					2

	CO2	1	1		3	4							2
	CO3	1	1		4	4		1					3
	CO4	1	1		4	4		1					4
BTEE15F6700	CO1	1					1						
	CO2	1	1			1				1			
	CO3		1			1			1				
	CO4	1	1									1	
BTEE15F6800	CO1	3	1	-	2	2	2	-	-	1	1	1	2
	CO2	3	2	-	2	2	1	-	-	1	-	1	2
	CO3	2	3	2	2	1	2	1	1	1	1	1	2
	CO4												
BTEE15F7100	CO1	1	1										
	CO2	1		1									
	CO3		1		1	1							
	CO4		1		1								
BTEE15F7200	CO1	2	2	3	2	2							2
	CO2	3	3	3	2	2							1
	CO3	1	3	2	3	2							2
	CO4	3	3	2	2	3							2
BTEE15F7300	CO1	1	3	2	2	1							
	CO2	2	2	2	2	1				1	2		
	CO3	2	1	3	1	2	1						

	CO4	2	1	2	2	1						1	
	CO5	2	1	1	2						2	2	2
	CO6	1						1	2				
	CO7	2	2	2	2	2			2	2	2	2	3
BTEE15F7401	CO1	1			1		1						
	CO2		1	1				1					
	CO3	1			1	1					1		
	CO4				1			1				1	
BTEE15F7402	CO1		1		1								
	CO2		1										
	CO3				1								
	CO4		1			1							
BTEE15F7403	CO1	2	2	2	2	2		1					
	CO2	2	1	2	1	1							
	CO3	2	1	2	1	1							
	CO4	2	1	2	1	1				1	2		
BTEE15F7404	CO1	1	2	1	1	2	1						
	CO2	2	1	1	2	2	1						
	CO3	1	2	1	1	3	1						
	CO4	2	1	2	3	3	1						
BTEE15F7501	CO1	1	2	1			1	1					
	CO2	2	3	2									
	CO3	3	2	2	1								
	CO4	2	3	1	1								
BTEE15F7502	CO1	2	3	3	3	1							

	CO2	2	3	2	2	1							
	CO3	2	3	2	2	1							
	CO4	2	3	2	2	1							
BTEE15F7503	CO1	3	3	3			1	2	1	2	3		
	CO2	3	3	2			1						1
	CO3	3	2	1	2	1			1		2		
	CO4	3				1	1	1		2			
	CO5	3					1		2	3			
BTEE15F7504	CO1	3											
	CO2		3										
	CO3	2		2									
	CO4	1	1		3								
BTEE15F7700	CO1	3	3	2	3								
	CO2	3	3	3	3		2						
BTEE15F7800	CO1		1	2	2	3							
	CO2		1	2	2	3							
	CO1	3	3	2	2	3				1			
	CO2	2	2	2	2	1				1	2		
BTEE15F8100	CO3	2	1	2	2	1						1	
	CO4	2	1	1	2						2	2	2
	CO5	2	2	2	2	2			2	2	2	2	3
BTEE15F8201	CO1	3	3	1									
	CO2	2	3	3		2							
	CO3	3	2	2									
	CO4	2	3	1		3	2						

BTEE15F8202	CO1	3	3	1			1	1					
	CO2	2	3	2									
	CO3	3	2	2	1								
	CO4	2	3	1	1								
BTEE15F8203	CO1	2	3	3	2	1	2						
	CO2	2	3	3	2	1							
	CO3	2	2	2	2	1							
	CO4	2	2	2	2	1							
BTEE15F8204	CO1	2	1		3								
	CO2				2	2	1						
	CO3	3	1	2									
	CO4	1	1		2								
	CO5	1	2		1								
	CO6		1		2	3							
	CO7		1		2	3							
BTEE15F8301	CO1	2	2	3				1					
	CO2	2	2	2		1							
	CO3	2	2	2		1		1					
	CO4	2	2	2		1		1					
BTEE15F8302	CO1	1	1				1						
	CO2		1		1	1				1			
	CO3		1			1			1			1	
	CO4			1		1		1			1		
BTEE15F8303	CO1	2	2	3	2	2	2	1					
	CO2	2	2	2	2	1	2	1					

	CO3	1	2	3	2	1	1	1					
	CO4	1	2	3	2	1	2	1					
	CO5	1	2	3	2	1	2	1					
BTEE15F8401	CO1		2	3	1	3	3	2	2	2	2	2	1
	CO2		2	3		2	2	2	2	2	2	2	1
	CO3		2	3		2	2	2	2	2	2	2	1
	CO4		2	3		2	2	2	2	2	2	2	1
BTEE15F8402	CO1	3	2	2				3		2		2	1
	CO2	2	1	3				3		2		2	1
	CO3	2	2	3				3		1		2	2
	CO4	3	1	3				3		2		2	1
	CO5	2	1	2				2		1		1	2
BTEE15F8403	CO1	2	2	1	2	1							
	CO2	2	2	2	2	2	1						
	CO3	1	2	1	2	1	1						
	CO4	1	2	1	2	1							
BTEE15F8404	CO1	1	2	3	2	2	3	3	1				
	CO2	2	2	2	2	1	1						
	CO3	1	2	2	2	1	2				2		
	CO4	1	2	2	1	1	1						

Mapping of PEOS with Respect to POs & PSOs

	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	

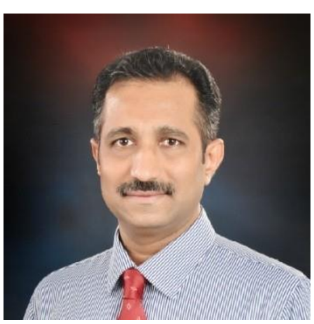
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO4	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

FACULTY MEMBERS PROFILE

Dr. Rajashekhar P. Mandi, Ph.D

Professor & Director, School of Electrical & Electronics Engineering

Dr. Rajashekar P. Mandi, Director, School of Electrical and Electronics Engineering, REVA University, holds Doctorate from NITK, Surathkal in the area of "Power and Energy" and holds M. Tech. degree with 3rd Rank in "Energy Systems Engineering" from BV Bhoomaraddi College of Engineering & Technology, Hubli of Visveswaraiah Technology University (VTU), Belgaum. He has one year of teaching experience. Prior to venturing into the field of academia, he has worked in Central Power Research Institute (CPRI) for 26 years in the area of Energy conservation, Energy audit, Power quality, Power system and Renewable energy systems. His teaching experience includes, teaching subjects like – Power quality, Facts controller, Electric Vehicle, Energy management, Renewable energy systems, etc., at the post-graduate level and PhD research scholars, and Electric power utilization, Electric machines, etc., at the undergraduate level. His area of interest is Energy conservation, Power quality, Power system and Renewable energy system. He is a professional member of IEEE. He is accredited energy auditor from Bureau of Energy Efficiency (BEE), Govt. of India. He is presently chairman of Society for Energy Efficiency & Manager (SEEM) Karnataka Chapter. He was member of several BIS committee in the area of electric lamps, electrical fans, solar PV, Batteries, electrical appliances, etc. He was also member of fixing ofstar label for LED lamps and electrical appliances for Bureau of Energy Efficiency, Govt. of India. He worked as nodal officer in Accelerated Power Development & Reforms Programme (APDRP). His research interests include renewable energy systems, energy conservation, strengthening of electrical distribution systems, electrical safety, power quality, LED lighting systems, etc. Presently he is guiding 5 PhD research scholars, guided 10 MTech. Projects and 15 BTech. Projects. He had written 3 book chapters on energy conservation in Thermal Powerplants and 2 book chapters in distributed power generation. He had published more than 117 technical papers in International & Indian Journals, Conferences & Seminars in the field of energy conservation, power quality, LED lighting system and renewable energy systems.



Dr. B.P. Divakar
Professor& Dean, Research & Innovation Council REVA University

Dr. B.P. Divakar completed B.E in Electrical and M.E. in power system in 1988 and 1992 respectively. He completed his Ph.D from theHong Kong polytechnic University in 1998 in power electronics. From 1998 - 2009 he served as research associate, research fellow, Lecturerat the Electrical Department of the same university. He has two US patents and won a meritorious award for a team project from the University. He joined RITM in

2009 as senior professor and became dean of Research of RU in 2013. He has 7 Journalpublications including 4 IEEE journals and over 40 international conferences. He is a recipient ofBest Teacher award from RU for his teaching contributions. His teaching experience includes, teaching subjects like Switched mode power conversion, Power Electronics applications using ICs, Power Supply systems, power Electronics applications in power system at the post-graduate level Networks Analysis, Engg Economics and Management, Electrical Machines, High Voltage Engg, Power system operation and control at the under-graduate level. He is guiding 6 research scholars in wide range of topics such as Multilevel inverter, Battery management system, Power factor controlling technique, rapid prototyping, Sensor less speed control, ultra-capacitor applications in electric vehicle, integrated charging technique for EVs and contingency analysis for power evacuation. He is the chair of REVA innovation club which is established to encourage multidisciplinary projects mentored by faculty across disciplines.

Prof. K. Narayana Swamy, M.Tech. (Ph.D)
Senior Associate professor

Prof. K. Narayana Swamy, Senior Associate professor, School of Electrical and Electronics Engineering., REVA University, holds M.E. degree in “Power Systems” from UVCE, Bangalore University and B.E. in “Electrical Power” from SJCE, Mysore University. He has 27 years of teaching experience. His teaching experience includes, teaching subjects like Switched Mode Power Conversion, Multilevel Inverters at the post- graduate level and Basic Electrical Engineering, Network Analysis, Electrical and Electronics Measurements, Electrical Machines, Control Systems, Power Electronics, Switch Gear and Protection, Electrical Machine Design, Electrical Power Utilization at the undergraduate level. His area of interest is DC-DC Converters and Multilevel Inverters.

Prof. Nagesh B.K., M.Tech. (Ph.D)
Associate Professor

Prof. Nagesh B.K. Associate Professor, School of Electrical and Electronics Engineering, REVA University, holds M.E. from Bangalore University, in Power Electronics from UVCE, Bangalore & pursuing Ph.D at VTU . He has 17 years of teaching experience. His teaching experience includes, teaching subjects like, Power Electronics, DC Machines & Synchronous Machines, Control engineering etc., at the undergraduate level. His area of interest is Power Electronics.

Prof. G S Mahesh, M.Tech. (Ph.D)
Associate Professor

Prof. G S Mahesh, Associate Professor, School of Electrical and Electronics Engineering, REVA University, holds M E in Applied Electronics, Madras University, and graduate degree in "EEE Stream" from MSRIT, Bangalore. He has 13 years of teaching experience. His teaching experience includes, teaching subjects like - Basic Electrical Engineering, Linear Integrated Circuits and Applications, Microcontrollers, Industrial Drives and Applications, Electrical Power Quality, Analog Electronics at the undergraduate level. His area of interest is Power Quality and Control Systems and currently perusing PhD in VTU.

Prof. Gopinath A, M.Tech. (Ph.D)
Associate Professor

Prof. Gopinath A, Associate Professor, School of Electrical and Electronics Engineering, REVA University, M. E. degree in Power & Energy System Engineering from UVCE, Bangalore and B E. degree in Electrical Engineering from BMSCE, Bangalore . He has 13 years of teaching experience. His teaching experience includes, teaching subjects like Computer Techniques in Power System Analysis, Power System Analysis & Stability, Modern Control Theory, HVDC Transmission at the graduate level. His area of interest is Plug-in Hybrid Electric Vehicles (PHEV) at the undergraduate level. He is pursuing PhD in Power Electronics at VTU, Belagavi.

Prof. Sudharani Potturi, MTech.
Senior Assistant Professor

Prof. Sudharani Potturi, Senior Assistant Professor, School of Electrical and Electronics Engineering, REVA University, M. Tech degree in Power Electronics & Industrial drives from JNTU, Hyderabad and B E. degree in Electrical & Electronics Engineering from JNTU, Hyderabad. She has 13 years of teaching experience. Her teaching experience includes, teaching subjects like Electrical Machines, Network Analysis, Electrical Power Generation, Electrical Power Utilization, High Voltage, Switchgear & Protection under UG and Power Semiconductor Devices, AC-DC Drives under PG.

Prof. G. Raghavendra, MTech. (Ph.D)
Assistant Professor

Prof. G. Raghavendra, Asst. Professor in the school of Electrical and Electronics Engineering holds B.E in Electrical and Electronics Engineering from Dr.TTIT, K.G.F and M.Tech in Digital Electronics from SSIT, Tumkur. He has 13 years of teaching experience, teaching various subjects like Network Analysis, Control systems, Modern control Theory, Electrical Drawing and Basic Electrical Engineering. His area of interest is in power systems currently pursuing PhD in Jain University.

Prof. Gangadharappa T. M., ME (Ph.D)
Assistant Professor

Prof. Gangadharappa T. M, Assistant Professor, School of Electrical and Electronics Engineering, REVA University, M. E. degree in Electronics & Communication from UVCE, Bangalore and B E. degree in Electronics & Communication Engineering from MS RAMAIAH, Bangalore . He is pursuing PhD in Embedded Systems under RU. He has 16.6 years of teaching experience. His teaching experience includes, teaching subjects like Basic Electrical & Electronics, Analog Electronic Circuits, Logic Design, Linear Integrated Circuits, Digital Signal Processing, Signals & Systems, Field Theory, VLSI, Control System, Embedded Systems under UG and Advanced Power Electronics under PG. His area of research interest is Embedded Systems.

Prof. Ashwini Kumari P., ME (Ph.D)
Asstt. Professsor

Prof. Ashwini Kumari P., Asstt. Professor, School of Electrical and Electronics Engineering, REVA University, holds M E degree in Power and Energy Systems from UVCE Bangalore and B E degree in Electrical and Electronics Engineering from Visvesvaraya Technological University Bangalore. She is pursuing PhD in Power Energy Systems under VIT, Vellore. She has 6 years of teaching experience. Her teaching experience includes, teaching subjects like -DC & Synchronous Machines, Control Systems, Advanced Control Systems, and Electrical power Generation and Distribution, Testing and Commissioning of Electrical Machines, Electrical Power utilization, Transformer and Induction Machines, and Elements of Electrical and Electronics Engineering at the undergraduate level. Her area of interest is Renewable Energy Systems.

Prof. Himabindu N, MTech (Ph.D.)
Assistant Professor

Prof. Himabindu N, Assistant Professor, School of Electrical and Electronics Engineering, REVA University, holds M.Tech degree in "VLSI Design and Embedded Systems" from RITM, Bangalore and B.Tech degree in "Electrical And Electronics Engineering" from SKIT, JNTU, Hyderabad. She is pursuing PhD in Renewable Energy Systems under RU. She has 3 years of teaching experience. Prior to venturing into the field of academia, she has experience of working in the experience Industry. Her teaching includes, teaching subjects like Embedded Systems at the

post-graduate level and VLSI, EPG, HV, SGP, RES at the undergraduate level. Her area of interest is Power Systems and Renewable Energy.

Prof. Viswanatha .V, ME, (Ph.D)
Assistant Professor

Prof. Viswanatha V, Asst. Professor, School of Electrical andElectronics Engineering., REVA University, holds ME degree in Power Electronics" from UVCE, Bangalore and Be degree in"Electronics and Communications" from Alpha College of Engineering, VTU, Belgaum. He has 6 year of teaching experience, pursuing Ph.D in Electronics at VTU, Belagaum. His teaching experience includes, teaching subjects like –Modeling and Simulation of Power Electronics, Real st-graduate level, and Digital Signal Processing, Signal and Systems, Microcontrollers, Power Electronics, Embedded System Design, Wireless communication at the undergraduate level. His area of interest is DSP Based Embedded Controllers design for Power Electronic Applications.

Prof. V. Christina Sundari, M.Tech.
Assistant Professor

Prof. V. Christina Sundari, Assistant Professor, School of Electrical Sciences, holds M. Tech. degree in "Power Electronics" and B. E. degree in" Electrical and Electronics Engineering" from VTU. She has over 5 years of teaching experience, teaching various subjects like Logic Design, Transformer and Induction Machines, Electrical Machine Drawing, Management and Entrepreneurship, Elements of Electrical and Electronics Engineering. She is interested in pursuing research in Industrial Drives.

Prof. Deepa K R, MTech.
Assistant professor

Prof. Deepa K R, Assistant professor, School of Electrical and Electronics Engineering, REVA University, holds M.Tech degree in “Computer application in industrial drives” from Sri Siddhartha Institute of technology , Tumkur and B.E degree in “Electrical and Electronics Engineering” from Sri Siddhartha Institute of technology, Tumkur, VTU, Belgam. She has 5.5 year of teaching experience. Her teaching experience includes, teaching subjects like –Electromagnetic compatibility at the post-graduate level, and Basic Electrical Engineering, Analog electronics, Control systems, Modern control theory, Operation research, Electrical drawing, electrical power utilization, Power system optimization and control, at the undergraduate level. Her area of interest is Power electronics.

Prof. K Nethra, MTech.
Assistant Professor

Prof. K Nethra, Assistant Professor, School of Electrical and Electronics Engg., REVA University, holds M.Tech degree in “Power Electronics “ from REVA ITM and B.Tech degree in “Electrical and Electronics Engineering” from REVA ITM, under VTU, Bangalore. She has 5 years of teaching experience. Her teaching experience includes, teaching subjects like Computer Aided Electrical Drawing, Electrical and Electronics Measurement and Instrumentation, Transmission and Distribution, Basic Electrical Engineering at the undergraduate level. Her area of interest is Electrical Drawing.

Prof. Seema Magadum, MTech.
Assistant professor

Prof. Seema Magadum, Assistant professor, School of Electrical and Electronics Engineering, REVA University, holds M.Tech degree in “Power & Energy Systems”, from NITK Surathkal and B.E degree in “Electrical and Electronics Engineering” from BEC Bagalkot. She has 5 years of teaching experience. Her teaching experience includes, teaching subjects like – Network analysis, Power System Planning, Electrical distribution systems, Basic Electrical Engineering, Operation research, CTPS at the undergraduate level and Power Electronics & Smart Grid, HVDC at PG level. Her area of interest is Smart Grid & Power Quality.

Prof. Arpita Banik, M.Tech.
Assistant Professor

Prof. Arpita Banik, Asst. Professor in the School of Electrical and Electronics Engineering holds B. Tech. in Electrical Engineering and M. Tech. in Power Electronics and Drives from NIT, Agartala, Triupra. Prof. Arpita Banik has 6 years of teaching experience. Her area of specialization is Power Electronics and Drives and her area of interest is AC-DC Convertor. She has taught various subjects at undergraduate level viz. Basic Electrical, Field Theory, Circuit Theory, Linear Control System, Power Electronics and Electrical Machines.

Prof. Rajini H., MTech (Ph.D)
Asst. Professor

Prof. Rajini H, Asst. Professor in the school of Electrical and Electronics Engineering holds B.E in Electrical and Electronics Engineering from SKIT, Bangalore and M.Tech in Power Systems from NIE, Mysore. She has 5 years of teaching experience, teaching various subjects like Power system Analysis & Stability, Computer techniques in Power system, Power System Operation & Control, Control Systems and Basic Electrical Engineering. Her area of interest is in power systems and High Voltage Engineering and currently pursuing PhD in VTU.

Prof. Saahithi S., MTech
Assistant Professor

Prof. Saahithi S, Assistant Professor, School of Electrical and Electronics Engineering, REVA University, holds M.Tech degree in "Computer Applications in Industrial Drives" from MSRIT, Bangalore and B.Tech degree in "Electrical And Electronics Engineering" from Aurora's Engineering College, JNTUH, Hyderabad. She has 3 years of teaching experience. Prior to venturing into the field of academia, she has experience of working in the Research field. Her teaching experience includes, teaching subjects like – AC/DC Drives at the post-graduate level, and Electrical circuits and machines, Basic Electrical Engineering, Electrical Measurements and Instrumentation at the undergraduate level. Her area of interest is Power Electronics and Drives.

Prof. Sujo Oommen, MTech
Assistant Professor

Prof. Sujo Oommen, Assistant Professor, School of Electrical and Electronics Engg., REVA University, holds M.Tech degree in "Power Electronics and Drives" from Karunya University and B.Tech degree in "Electrical and Electronics Engineering" from St. Joseph College of Engineering and Technology, Palai, Kerala under M G University. She has

4 years of teaching experience. Her teaching experience includes, teaching subjects like Power Electronics, Signals and Systems, Basic Electrical Engineering, Electric Power Generation, Electrical Machines and others at the undergraduate level. Her area of interest is Power Electronics.

Prof. Mahesh Kumar, M.Tech.
Assistant Professor

Prof. Mahesh Kumar, Assistant Professor, School of Electrical and Electronics Engg. REVA University, holds M.Tech degree in "Power Electronics Stream Electrical and Electronics Engineering" in 2015 from REVA Institute of Technology& Management, B.E degree in "Electrical and Electronics Engg." from REVA Institute of Technology& Management in 2012 from, Visveshwaraya Technological University Belagavi and has Diploma in Electrical and Electronics Engineering in 2009. He has 4 years of teaching experience. His teaching experience includes, teaching subjects like – Electrical Power Utilization, Basic Electrical Engg, Electrical Power Generation, Logic Design, Computer Aided Electrical Drawing, at the undergraduate level. His area of interest is Power Electronics Multilevel Inverters and DC to DC converters.

Prof. N. Mamatha, M.Tech.
Assistant professor

Ms. N. Mamatha, Asst. Professor in the School of Electrical and Electronics Engineering holds B.E. in Electrical & Electronics Engineering from Siddaganga Institute of Technology, Tumkur and M. Tech. in Power Electronics from REVA Institute of Technology & Management (RITM), Bangalore. Prof. Mamatha N has more than 2 years of

teaching experience. She has also worked in KPTCL as a Graduate Trainee for one year. Her area of specialization is Power Electronics. Her area of interest is Inverters, Solar Generators, She has taught various subjects at undergraduate level viz., Power Electronics, Microprocessor 8051, Electrical Power Generation and basic electrical engineering. She has submitted a project on "Design of Transformers and Inverter for 3 MW grid converted Solar PV plant at Kolar, carried out under KPCL. She has attended a National Conference on "Performance Analysis of 3 KW grid converted solar PV plant at Kolar and National Conference on "Fuzzy Logic based MPPT method for solar converter".

Prof. Ramya N., MTech.
Assistant Professor

Prof. Ramya N, Assistant Professor, School of Electrical and Electronics Engg., REVA University, holds M.Tech degree in "Computer Applications in Industrial drives" from MSRIT, Bangalore and B.E degree in "Electrical and Electronics Engineering" from VVCE, Mysore. She has 3 years of teaching experience and 2 years of industry. Her teaching experience includes, teaching subjects like

EMD, IDA, Basic Electrical Engineering at the undergraduate level. Her area of interest is High Voltage Engg. and Insulation systems.

Prof. Divya K S., MTech
Assistant Professor

Prof. Divya K S, Assistant Professor, School of Electrical and Electronics Engg., REVA University, holds MTech degree in “Power systems and Power electronics” from IIT Madras and BTech degree in “Electrical Engineering” from MANIT Bhopal. She has 2 years of teaching experience. Prior to venturing into the field of academia, she has experience of working in flight simulation field. Her teaching experience includes, teaching subjects like –Modeling and Simulation of Power Electronic Systems, DC-DC Converters, Power electronics design using IC’s, Control of Drives at the post-graduate level, and Advanced Power Electronics at the undergraduate level. Her areas of interest are Power Systems Modeling, Power electronics and Control Systems.

PROF. Divya B V., MTech
Asst. Professor

Prof. Divya .B.V, Asst. Professor in School of Electrical Engineering holds M.Tech degree in ‘Power Electronics’ from Visvesvaraya University, B.E degree in ‘Electrical and Electronics Engineering’ from Visvesvaraya Technological University. Prof. Divya. B.V has 2.5 years of teaching experience. Her area of interest is FACTS Controllers. She has taught subjects in Undergraduate level viz. Transformers and Induction Machines, Electrical Power Generation, Modern Control Theory, Electrical Machine Design, DC Machines and Synchronous Machines and Power Electronics etc. In Postgraduate level, she has taught Power Semiconductor Devices. She has attended 3 workshops on various subjects

Prof. Lavanya Neerugattu, MTech
Assistant Professor

Prof. Lavanya Neerugattu, Assistant Professor, School of Electrical and Electronics Engg. REVA University, holds M.Tech degree in "Power Electronics, Stream Electrical and Electronics Engineering" in 2012 from VNR Vignana Jyothi Institute of Engineering & Technology, BTech degree in "Electrical and Electronics Engg." from Madanapalle Institute of Technology& Sciences in 2010 from, JNTU Anantapur. She has 3 years of teaching experience. Her teaching experience includes, teaching subjects like – Electrical Measurements and Instrumentation, Basic Electrical Engg, Electrical Wiring, at the undergraduate level. His area of interest is Power system voltagestability.

Prof. Latha N., MTech.
Assistant Professor

Prof. Latha. N, Asst. Professor in School of Electrical Engineering holds M.Tech degree in Power Electronics from Visvesvaraya University, B.E degree in Electrical & Electronics Engg. from Visvesvaraya Technological University. Prof. Latha. N, has 2.5 years of teaching experience. She has taught subjects in Undergraduate level viz. Basic Electrical Engineering, Electrical Power Generation, Renewable Energy Sources and Electrical and Electronic Measurements and Instrumentation etc. In Postgraduate level, she has taught Power Semiconductor Devices, Application of ICs in design of Power electronic Circuits. She has attended 3 workshops on various subjects. Her area of interest is Multilevel Inverter.

Prof. Sagar B S., MTech
Assistant Professor

Prof. Sagar B S, Assistant Professor, School of Electrical and Electronics Engineering., REVA University, holds M. Tech degree in "Power Electronics" from RITM and B.E degree in "Electronics and Communication Engineering" from RGIT, VTU, Bangalore. He has two years of teaching experience and also has experience as Research Assistant for 8 months. His teaching experience includes, teaching subjects like Analog Electronics Circuits, Microcontrollers, Linear Integrated Circuits, Basic Electrical Engineering at the undergraduate level. His areas of interest are Battery Management System and digital control.

Prof. Doddabasappa N., MTech
Assistant Professor

Prof. Doddabasappa N, Assistant Professor, School of Electrical and Electronics Engg. REVA University, holds M.Tech degree in "Computer Applications in Industrial Drives" in 2015 from MS Ramaiah Institute of Technology , B.E degree in "Electrical and Electronics Engg." from HMS Institute of Technology in 2011 from, Visveshwaraya Technological University Belagavi. His area of interest is Power Electronics Inverters and Dual Buck Inverters

Prof. Santhosh G., MTech
Assistant Professor

Prof. Santhosh G, Assistant Professor in the school of Electrical and Electronics Engineering holds B.E in Electrical and Electronics Engineering from M S Engineering College, Bangalore and M-Tech in Computer Application in Industrial Drives from The Oxford College of Engineering, Bangalore. His area of interest is in Electrical Drawing, Power Electronics and Drives.

DO’S AND DON’TS

DO’S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON’TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbors.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.
2. Healthy suggestions are welcome for betterment of Institution

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

M. TECH – COMPUTER SCIENCE & ENGG.
FIRST YEAR HANDBOOK[FULL TIME]

2017-19

Rukmini Educational
Charitable Trust

SCHOOL OF COMPUTER SCIENCE & ENGINEERING

M.Tech (Computer Science Engineering) Program

HANDBOOK

2017-19

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-66226622, Fax: 080-28478539

Rukmini Educational Charitable Trust

www.reva.edu.in

Chancellor's Message

"Education is the most powerful weapon which you can use tochange the world."
- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information andthose who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter ourportals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challengecognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVAUniversity to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerelythat it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of thefaculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the researchis passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft- skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King,Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to providepremium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr.S Y Kulkarni
Vice-Chancellor,
REVA University

Director's –Message

I congratulate and welcome all the students to the esteemed school of Computing and Information technology (IT). You are in the right campus to become a computer technocrat. The rising needs of automation in Industry 4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of computers and IT. The B.Tech and M.Tech program curriculum and Ph.D areas in the school are designed to cater to the requirements of industry and society. The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, AMD, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc).

This handbook presents the M.Tech in Computer Science and Engineering program curriculum. The program is of 2 years duration and split into 4 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of CSE. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, AI, Data Science, and Systems. Theoretical foundations of engineering, science, and computer science are taught in first two Semesters. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization.

The important features of the M.Tech CSE are as follows: 1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, Genetic Engineering, NLP, Swarm Intelligence, IOT and Cybersecurity, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft skillstraining and 10) Platform for exhibiting skills in cultural, sports and technical activities through clubs and societies.

The curriculum caters to and has relevance to local, national, regional, and local developmental needs. Maximum number of courses are interpreted with cross cutting issues relevant to professional ethics generic human values environmental and sustainability.

The school has well qualified faculty members in the various areas of computing and IT including cloud computing, security, IOT, AI, ML and DL, software engineering, computer networks, cognitive computing, etc. State of art laboratories are available for the purpose of academics and research.

Dr.Sunilkumar S Manvi

Director, School of C&IT, REVA University

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust (RECT) is a PublicCharitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVAInstitute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVAInstitute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions,the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of theTrust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The ideaof creating these top notched educational institutions was born of the philanthropic instincts of Dr.
P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, giftingassets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. TheUniversity is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, facultymembers and supportive staff.

REVA consistently ranked as one of the top universities in various categories because of the diversecommunity of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The Universityoffers world-class facilities and education that meets global standards.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the schemeof instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS –CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those whohave the capabilitiesto surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes,etc., for slow learners so as to give them the needed input and build in them confidence and courageto move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation divisionheaded by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovativeprojects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, ResourceManagement and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce thesaid skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor& Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitatingstudent's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University,Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conducttraining programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leadersof tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N RNarayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga class'severyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Vision

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

Misson

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubationcenters.
- To provide student-centric learning environment through innovative pedagogy and educationreforms.
- To encourage research and entrepreneurship through collaborations and extension activities.
- To promote industry-institute partnerships and share knowledge for innovation anddevelopment.
- To organize society development programs for knowledge enhancement in thrust areas.
- To enhance leadership qualities among the youth and enrich personality traits, promotepatriotism and moral values.

Objectives

- Creation, preservation and dissemination of knowledge and attainment of excellence indifferent disciplines.
- Smooth transition from teacher - centric focus to learner - centric processes and activities.
- Performing all the functions of interest to its major constituents like faculty, staff, students andthe society to reach leadership position.

- Developing a sense of ethics in the University and Community, making it conscious of itsobligations to the society and the nation.
- Accepting the challenges of globalization to offer high quality education and other services in acompetitive manner.

About the School of Computing and Information Technology (C & IT)

The School has a rich blend of experienced and committed faculty who are well-qualified in variousaspects of computing and information technology apart from the numerous state-of-the- art digital classrooms and laboratories having modern computing equipment. The School offers one undergraduate program: B Tech in Computer Science and Engineering and Three postgraduate programs offered in the school are: M Tech in Data Engineering and Cloud Computing and M Tech in Computer Science and Engineering(Both Full Time & Part Time). In addition, the school has a unique academic collaboration with the University of Alabama in Huntsville to jointly offer an MS program in Computer Science. In addition, the school has are search center in which students can conduct cutting edge research leading to a PhD degree.

Curricula of both undergraduate and postgraduate programs have been designed through a collaboration of academic and industry experts in order to bridge the growing gap between industry and academia. This makes the program highly practical-oriented, and thus industry- resilient. The B Tech program aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world. The masters' degrees focus on quality research and design in the core and application areas of computing to foster a sustainable world and to enhance the global quality of life by adopting enhanced design techniques and applications. This thought is reflected in the various courses offered in the masters' programs.

Vision

To create a pool of high-caliber technologists and researchers in computer science and informationtechnology who have potential to contribute to the development of the nation and the society with their expertise, skills, innovative problem-solving abilities, and strong ethical values.

Mission

- Create a center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders, and innovators.
- Provide quality education in both theoretical and applied foundations of computer science, information technology and related inter-disciplinary areas and to train students to effectivelyapply the education to solve real-world problems.
- Amplify students potential for life-long high-quality careers and give them a competitive advantage in the ever-changing and challenging global work environment of the 21st century.
- Forge research and academic collaboration with industries and top global universities in orderto provide students with greater opportunities.
- Support the society by encouraging and participating in technology transfer Quality Policy.

Advisory Board

Serial Number	Name and Designation of the Members
1	Mr. Himesh Misra,Program Director, IBM Innovation Center, IBM India Private Limited Bengaluru-560017
2	Dr. Rajkumar Buyya,Director, Cloud Computing and Distributed Systems Laboratory Department of Computing and Information Systems University of Melbourne, Australia
3	Mr. Chethan Shivkumar, Founding Director, AIKAAN Labs, Bengaluru
4	Mr. P. B. Kotur, Global Goodwill Ambassador Wipro Limited Bengaluru, India
5	Dr. Sajal Das, Professor, Department of CS&E Missouri University of Science and Technology, USA
6	Dr. Heggere S Ranganath, Professor and Chair, Computer Science Department University of Alabama in Huntsville Huntsville, AL 35899, USA
7	Mr. Mrityunjay Hiremath, Director, AMD Inc. USA, Bengaluru
8	Dr. Shirshu Verma, Professor and Registrar, IIIT Allahabad Allahabad, India
9	Dr. K. Gopinath, Professor, Dept. of Computer Science and Automation IISc., Bengaluru
10	Dr. S. S. Iyengar,Professor, Louisiana State University (LSU), USA.

MEMBERS OF BOARD OF STUDIES

Sl. No	Name and Affiliation	Role
1	Dr Sunil Kumar S Manvi, Professor and Director School of C & IT, REVA University	Chairman
2	Dr Mallikarjuna Shastry P M, Professor School of C & IT, REVA University	Member
3	Dr Kiran Kumari Patil, Director UIIC REVA University	Member
4	Dr Mallikarjuna M Kodabagi, Professor and Deputy Director IQAC, REVA University	Member
5	Dr Ashwin Kumar U M, Associate Professor, School of C & IT, REVA University	Member
6	Dr Gopala Krishna Shyam, Associate Professor, School of C & IT, REVA University	Member
7	Mr. Chetan Shivakumar, CEO & Cofounder, Aikaan Labs Pvt Ltd, Bengaluru.	Member
8	Mr. Muralidhar Jahagirdhar, Practice Head Engineering, ATMECS Technology Pvt Ltd, Hyderabad	Member
9	Mr. Ravikant Soni, Technical Manager, Solution Architect, Standard Chartered bank, Bengaluru.	Member
10	Dr Sanjay, HoD Dept. of ISE, NITTE Meenakshi Institute of Technology, Bengaluru	Member
11	Dr Raghavendra Kulkarni, Director of Academics, M. S. Ramaiah University of Applied Sciences, Bengaluru	Member

Program Overview

M Tech (Computer Science & Engineering) Program

Computer Science Engineering (CSE) encompasses a variety of topics that relates to computation, like development of algorithms, analysis of algorithms, programming languages, software design and computer hardware. Computer Science engineering has roots in electrical engineering, mathematics, and linguistics. In the past Computer Science was taught as part of mathematics or engineering departments and in the last 3 decades it has emerged as a separate engineering field. Inthe present information era (Knowledge era) computer science and engineering will see an exponential growth as the future machines work on artificial intelligence.

The oldest known complex computing device, called the Antikythera mechanism, dates back to 87 B.C., to calculate astronomical positions and help Greeks navigate through the seas. Computing tookanother leap in 1843, when English mathematician Ada Lovelace wrote the first computer algorithm, in collaboration with Charles Babbage, who devised a theory of the first programmable computer. But the modern computing- machine era began with Alan Turing's conception of the Turing Machine, and three Bell Labs scientists invention of the transistor, which made modern- stylecomputing possible, and landed them the 1956 Nobel Prize in Physics. For decades, computing technology was exclusive to the government and the military; later, academic institutions came online, and Steve Wozniak built the circuit board for Apple-1, making home computing practicable. On the connectivity side, Tim Berners-Lee created the World Wide Web, and Marc Andreessen builta browser, and that's how we came to live in a world where our glasses can tell us what we're looking at. With wearable computers, embeddable chips, smart appliances, and other advances in progress and on the horizon, the journey towards building smarter, faster and more capable computers is clearly justbeginning.

Computers have become ubiquitous part of modern life, and new applications are introduced everyday. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse. Since 2001, global information and communication technologies (ICTs) have become more powerful, more accessible, and more widespread. They are now pivotal in enhancing competitiveness, enabling development, and bringing progress to all levels of society.

The career opportunities for computer science and engineering graduates are plenty and growing. Programming and software development, information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the opportunities the graduates find.

The School of Computing and Information Science at REVA UNIVERSITY offers M.Tech., Computer Science and Engineering programme to create motivated, innovative, creative thinking graduates tofill ICT positions across sectors who can conceptualize, design, analyse, and develop ICT applicationsto meet the modern day requirements.

The M.Tech., in Computer Science and Engineering curriculum developed by the faculty at the School of Computing and Information Science, is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, innovative, creative thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strongconnections with ICT sector makes this programme unique.

Program Educational Objectives (PEO’s)

After few years of graduation, the graduates of M. Tech. (Computer Science and Engineering) will:

PEO-1: Have successful professional careers in industry, government, academia and military as innovative engineers.

PEO-2: Successfully solve engineering problems associated with the lifecycle of Computer Science and Engineering either leading a team or as a team member.

PEO-3: Continue to learn and advance their careers through activities such as research and development, acquiring doctoral degree, participation in national level research programme, teaching and research at university level etc.

PEO-4: Be active members ready to serve the society locally and internationally, may take up entrepreneurship for the growth of economy, to generate employment and adopt the philosophy of lifelong learning to be aligned with economic and technological development.

Program Outcomes (POs)

After successful completion of the programme, the graduates shall be able to

PO1. Demonstrate in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2. Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical,practical and policy context.

PO3. Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide rangeof potential solutions for those problems and arrive at feasible, optimal solutions after considering publichealth and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4. Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5. Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of thelimitations.

PO6. Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self- management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7. Demonstrate knowledge and understanding of engineering and management principles and apply the same to one’s own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8. Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competencecontinuously.

PO10. Acquire professional and intellectual integrity, professional code of conduct, ethics of research andscholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11. Observe and examine critically the outcomes of one’s actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback (SELF learning)

Programme Specific Outcomes (PSO's)

After successful completion of the programme, the graduates shall be able to

1. Isolate and solve complex problems in the domains of Computer Science and Engineering using latest hardware and software tools and technologies, along with analytical and managerial skillsto arrive at cost effective and optimum solutions either independently or as a team

2. Implant the capacity to apply the concepts of wireless communications, advanced computer networks, network security, IoT and cyber physical systems, etc. in the design, development of software

3. Review scholarly work by referring journals, define a new problem, design, model, analyze and evaluate the solution and report as a dissertation in the area of Computer Science and Engineering.

Summary of REVA University Regulations for Choice Based Credit System (CBCS)and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0. A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

2.1. Various course of s**tudy** are labeled and defined as: (i) Core Course (CC) (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(iii) Hard Core Course (HC):

The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iv) Soft Core Course (SC):

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(v) Open Elective Course:

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **Six to Eight credits** is called **Minor Project** work.A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE, SIXTEEN or TWENTY** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be earned:

3.1. A candidate has to earn 96 credits for successful completion of M Tech degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 26 credits per Semester. However he / she may notsuccessfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by acandidate.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered fordeclaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M .Tech degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 96 credits for the M. Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B. Tech degree. The A**dd -on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5.0. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 Components as C1, C2, and C3.**The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component C1:

The first Component (C1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th Wk.), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th Wk. of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th Wk.. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th Wk.. The academic sessions will continue for C2 immediately after completion of processof C1.

The finer split - up for the award of marks in C1 is as follows:

Assignment... 05 marks for Unit 1&2

Seminar.. 05 marks for Unit 1&2

Test (Mid-Term).. 15 marks for Unit 1&2

Total... 25 marks

(ii) Component C2:

The second component (C2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th Wk.) will be consolidated during 16th Wk. of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be conducted and completed during 16th Wk. of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th Wk..
The 17th Wk. will be for revision of syllabus and preparation for the semester - end examination.

The finer split - up for the award of marks in C2 is as follows:
Assignment..05 marks for Unit 3 & 4
Seminar...05 marks for Unit 3 & 4
Review Test (Mid-Term).............................15 marks for Unit 3 & 4
Total...25 marks

(iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th Wk.. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

5.2. Setting Questions Papers and Evaluation of Answer Scripts:

5.2.1. There shall be three sets of questions papers set for each course. Two sets of question papers shall be set by the internal and one set by external examiner for a course. The Chairperson of the BoE shall get the question papers set by internal and external examiners.

5.2.2. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

5.2.3. There shall be single valuation for all theory papers by internal examiners. In case, the number of internal examiners falls short, external examiners may be invited. The answer scripts evaluated both by internal and external examiners shall be moderated by the external examiner / moderator.

5.2.4. The examination for Practical work/ Field work/Project work will be conducted jointly by two examiners (internal and external). However, in case of non-availability of external examiner or vice versa, the Chairperson BoE at his discretion can invite internal / external examiners as the case may be, if required.

5.2.5. If a course is fully of (L=0):T: (P=0) type, then the examination for C3 Component will be as decided by the BoS concerned.

5.2.6. In case of a course with only practical component a practical examination will be conducted with two examiners (ref: 6.3.4 above) and each candidate will be assessed on the basis of: a) Knowledge of relevant processes, b) Skills and operations involved, and c) Results / Products including calculation and reporting.

5.2.7. The duration for semester-end practical examination shall be decided by the School / Council.

5.3. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

5.4. The schedule of continuous assessment and examinations are summarized in the following Table below.

Component	Period	Syllabus	Weightage	Activity
C1	1st Wk. to 8th Wk.	First 50% (two units)	25%	Instructional process and Continuous Assessment
	Last 3 days of 8th Wk.	First 50% (two units)		Consolidation of C1
C2	9th Wk. to 16th Wk.	Second 50% (remaining two units)	25%	Instructional process and Continuous Assessment
	Last 3 days of 16th Wk.	Second 50% (remaining two units)		Consolidation of C2
C3	17th and 18th Wk.			Revision and preparation for Semester end examination
	19th Wk. to 20th Wk.	Entire syllabus	50%	Conduct of semester end examination and Evaluation concurrently
	21st Wk.			Notification of Final Grades
***Evaluation shall begin very first day after completion of the conduct of examination of the first course and both examination and evaluation shall continue concurrently. The examination results / final grades be announced latest by 21st Wk.**				

Note: 1. Practical examination wherever applicable shall be conducted before conduct of C2 Examination. The calendar of practical examination shall be decided by the respective School.

2. Finally**, awarding of the Grades** be announced latest by 5 days after completion of the examination.

6.0 Requirements to Pass a Course

6.1. A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 30% marks in C1 and C2 together, and 40% and above in aggregate of C1, C2 and C3 in a course is said to be successful.

6.2. Eligibility to Appear for C3 (Semester - end) Examination and Provision to Drop the Course.

Only those students who fulfill 75% of attendance requirement and who secure minimum 30% marks in C1 andC2 together in a course are eligible to appear for C3 examination in that course.

6.3. Those students who have 75% of attendance but have secured less than 30% marks in C1 and C2 together in a course are not eligible to appear for C3 examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

Teachers offering the courses will place the above details in the School Council meeting during the last Wk. of theSemester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

6.4. In case a candidate secures more than 30% marks in C1 and C2 together but less than 40% marks in aggregate of C1, C2 and C3 in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for C3 examination during the subsequent semesters / years within the stipulated period.

In such a case wherein he / she opts to appear for just C3 examination, then the marks secured in C1 and C2 shall get continued. Repeat C3 examination will be conducted in respective semesters.

6.5. In case a candidate opts to drop the course he / she has to re-register for the dropped course only in subsequent semesters whenever it is offered if it is Hard Core Course. He / she may choose alternative course if it is Soft Core Course or Open Elective course or Skill Development Course.

The details of any dropped course will not appear in the Grade Card.

6.6. Provision to Withdraw Course:

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective. **A DROPPED course is automatically considered as a course withdrawn.**

7.0. Provision for Make- up Examination:

For those students who have secured less than 40% marks in C1, C2 and C3 (end semester examination) together; the university shall conduct a make-up C3 examination within three Wk.s after the end of each semester.

Such of those students who have secured more than 30% marks in C1 and C2 together and less than 40% marks in C1, C2, and C3 together in a course shall appear for make-up examination in that course. This make-up examination is only for C3examination.

A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance and performance requirements in C1 & C2 shall appear for make-up examination.

7.1 The candidate has to exercise his/her option immediately within 10 days from the date of notification of results. A MAKE-UP examination will be conducted within 25 days from the date of notification of results. If the candidate still remains unsuccessful after MAKE-UP examination he/she is said to have DROPPED that course

7.2 Re-Registration and Re-Admission:

A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for end semester examination (C3) shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

In case a candidate fails in more than 2 courses in odd and even semesters together in a given academic year, he / she may either drop all the courses and repeat the semester or reappear (C3 semester end examination) to such of those courses where in the candidate has failed during subsequent semester / year within a stipulated period.

7.3 In such a case where in a candidate drops all the courses in semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

7.4 Requirements to Pass the Semester andProvision to Carry Forward the Failed Subjects / Courses:

7.4.1 A candidate who secures a minimum of 30% in C1 and C2 and 40% and above in aggregate of C1, C2 and C3 in all the courses with credits prescribed in a semester is said to have passed that semester.

7.5. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in 4 courses in 1st and 2nd semesters together shall move to 3rd semester. And he / she shall appear for C3 examination of failed courses of the said semesters concurrently with 3rd semester end examinations (C3) and 4th semester end examinations (C3) of second year of study.

8.0 Attendance Requirement:

8.1. All students must attend every lecture, tutorial and practical classes.

8.2. In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

8.3. Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (C3) examination.

8.4. Teachers offering the courses will place the above details in the School / Department meeting during the last Wk. of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of theRegistrar & Registrar (Evaluation).

8.5. Absence during mid semester examination

In case a student has been absent from a mid semester examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester examination.

8.6. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

9. Provisional Grade Card:

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully.

The provisional grade card provides **Semester Grade Point Average** (SGPA).This statement will not contain the list of DROPPED courses.

9.1 Challenge Valuation:

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the Grade awarded to him/her by surrendering the Grade Card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for C3 component.

The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.

9.2 Final Grade Card: Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

9.3 The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks	Grade	Grade Point	Letter Grade
P	G	(GP=V x G)	
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	v*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail;

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

9.4 Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = $\sum$(Ci x Gi) / $\sum$Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)

Course 1	**4**	**A**	**9**	**4X9=36**
Course 2	**4**	**B**	**8**	**4X8=32**
Course 3	**4**	**C**	**7**	**4X7=28**
Course 4	**4**	**O**	**10**	**4X10=40**
Course 5	**4**	**D**	**6**	**4X6=24**
Course 6	**4**	**O**	**10**	**4X10=40**
	24			**200**

Thus, **SGPA = 200 ÷ 24 = 8.33**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**5**	**A**	**9**	**5X9=45**
Course 2	**5**	**C**	**7**	**5X7=35**
Course 3	**5**	**A**	**9**	**5X9=45**
Course 4	**5**	**B**	**8**	**5X8=40**
Course 5	**4**	**O**	**10**	**4X10=40**
	24			**205**

Thus, **SGPA = 205 ÷ 24 = 8.54**

9.5 Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for two year post graduate degree in Computer Science & Engineering is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 =204.96
3	24	9.35	24x9.35=224.4
4	24	9.50	24x9.50=228.0
Cumulative	96		857.28

Thus, **CGPA** = 24x8.33+24x8.54+24x9.35+24x9.50 = 8.93

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.93 x 10=89.30

9.6 Classification of Results

		FGP

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	Numerical Index	Qualitative Index
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

10.0.Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate ifhis/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

11.0. Grievance Cell

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

12.0. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Course Numbering Scheme

List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering /
MA	Master of Arts	DE	Data Engineering and Cloud Computing
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M. Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

MTech in Computer Science and Engineering(Full Time)

Scheme of Instruction for Academic Year 2017-19

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Credit Value			
				L	T	P	Total
FIRST SEMESTER							
1	MTCS17F1100	Advanced Database Management Systems	HC	4	0	1	5
2	MTCS17F1200	Cloud Computing	HC	4	0	1	5
3	MTCS17F1300	Machine Learning and Deep Learning	HC	4	1	0	5
4	MTCS17F1410	Advanced Web Technologies	SC	4	1	0	5
	MTCS17F1420	Advanced Storage Area Networks					
	MTCS17F1430	Statistical Data Modeling and Analysis					
5	MTCS17F1510	Image Processing	SC	4	1	0	5
	MTCS17F1520	Mobile Application development					
	MTCS17F1530	Agile Software Development					
6	MTCS17F1610	Python Programming	SC	4	1	0	5
	MTCS17F1620	Robotics					
	MTCS17F1630	Advanced Data Structures					
						Total Credits for the First Semester	**30**
SECOND SEMESTER							
1	MTCS17F2100	Principles of Algorithm Design (DAA)	HC	4	0	1	5
2	MTCS17F2200	Big Data and Analytics Using R	HC	4	0	1	5
3	MTCS17F2300	Internet of Things	HC	4	1	0	5
4	MTCS17F2410	Computer Network Engineering	SC	4	1	0	5
	MTCS17F2420	Research Methodology					
	MTCS17F2430	Open Source Cloud Computing Tools					
	MTCS17F2510	Unix Operating System & Internals					

5	MTCS17F2520	Cyber Security	SC	4	1	0	5	
	MTCS17F2530	Advanced Java Programming						
6	MTCS17F2610	Parallel Computing and Programming	SC	4	1	0	5	
	MTCS17F2620	Human Computer Interaction (UI/UX Design)						
	MTCS17F2630	Embedded Computing systems						
		Total Credits for the Second Semester					**30**	

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Credit Value				No. of Hrs.
THIRD SEMESTER								
1	MTCS17F3110	Text and Web Mining	SC	3	1	0	4	5
	MTCS17F3120	Soft Computing						
	MTCS17F3130	Wireless Networks						
2	MTCS17F3200	Internet Computer and Applications	OE	3	1	0	4	5
3	MTCS17F3300	Project Phase-1	HC	0	0	2	2	4
4	MTDE17F3400	MOOCS / Internship	HC	-	-	-	3	
5	MTDE17F3500	Global Certification	HC	-	-	-	3	
	Total Credits for the Third Semester						**16**	**34**
FOURTH SEMESTER								
1	MTCS17F4100	Project Phase-2 and Dissertation	HC	2	4	14	20	40
Total Credits for the Fourth Semester							**20**	**40**
Total Credits for all Four Semesters is 96.								

Note:

1. **Internship** should be carried out in a reputed /Tier-1/R & D organization, preferably, internship should be with stipend. The internship should be approved by the REVA University authorities before completion of 3rd semester and the students should

obtain the permission for the same by producing the necessary details of company, selection process, and the offer letter issued by the company. At the end of the Internship, detailed report must be submitted.

2. Students can take-up the **internship** only if it is approved by RU authorities.

3. **Project work phase 1** comprises of literature survey, review paper writing, and problem formulation, identification of tools and techniques, and methodology for the project.

Project work phase – 2, in 4th semester should have an outcome: publication in a

reputed National/International Journal or a patent filing to earn 2 credits

4. **Global Certification programs:** Students have to register for global certification programs of their choice such as networking, JAVA, ORACLE, etc. The students can also choose skill development programs conducted by the UIIC or School, which may not be globally certified. However, weightage is more for global certification courses (10% weightage is accounted less for non-global programs). The registration must happen before beginning of the third semester.

I Year Detailed Syllabus

M. Tech in Computer Science and Engineering (Full Time)

First Semester

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs/ Wk
MTCS17F1100	Advanced Database Management Systems	16	HC	4	0	1	5	6

Course Objectives:

The objectives of this course are to:

1. Introduce the Object oriented concepts and object relational Databases;
2. Acquire knowledge on parallel and distributed databases and its applications;
3. Study the concepts of advanced databases like Data Warehousing and Data Mining;
4. Learn emerging and advanced data models;

Course Outcomes:

On successful completion of this course; the student will be able to:

CO1: Solve queries using SQL for real world applications.

CO2: Make use of the Object oriented concepts in relational databases for real world applications.

CO3: Design parallel and distributed databases, Query database and incorporate recovery mechanisms.

CO4: Develop Enhanced Data Model for given real world applications.

Course Contents:

Unit 1

Introduction to DBMS: Basics of DBMS and SQL

Unit- 2

Overview of Object-Oriented Concepts, Object and Object-Relational Databases: Objects, Encapsulation, Polymorphism, Type and class hierarchies etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; Conceptual design of Object database; Overview of object relational features of SQL; Object-relational features of oracle.

Unit -3

Parallel and Distributed Databases: Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.

Unit- 3

Data Mining: Introduction to decision support, OLAP, multidimensional model, Window queries in SQL, Finding answers quickly, Implementation techniques for OLAP, Data Warehousing, Introduction to Data Mining, Counting co-occurrences, Mining for rules, Tree-structured rules, Clustering, Similarity search over sequences, Incremental mining and data streams;

Unit- 4

Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases-Basic concepts. More Recent Applications: More Recent Applications: Mobile databases; Mutimedia databases; Geographical Information System; Genome data management.

Recommended Learning Resources:

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2003.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier, 2011.
4. Connolly and Begg, Database Systems, 4th Edition, Pearson Education, 2002.
5. Journal of Data and Information Quality (JDIQ)
6. ACM Transactions on Knowledge Discovery from Data (TKDD)
7. ACM Transactions on Database Systems (TODS)
8. ACM Transactions on Storage (TOS)
9. IEEE Transactions on Knowledge and Data Engineering

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	1					1	1	1	3	2
CO2	3	3	2	3	2					1	1	2	3	3
CO3	3	2	3	1	2						2	1	3	2
CO4	3	3	3	2	2						1	1	3	3

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Week)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F1200	**Cloud Computing**	**16**	**HC**	**4**	**0**	**1**	**5**	**6**

Prerequisites:

Students should have basic knowledge about Computer Networks and Operating System.

Course Objectives:

The objective of this course is to:

1. Provide knowledge in different layers of cloud computing, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS);
2. Compare and contrast different Cloud service delivery models.
3. Illustrate the use of various cloud computing technologies;
4. Provide Introduction to cloud security and secure computation in the cloud.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

CO1: Analyze the distinctions between Infrastructure, Platform and Software as a Service (IaaS, PaaS, SaaS) abstractions

CO2: Analyze the advantages and disadvantages of Public and Private Clouds and apply it for different scenarios.

CO3: Develop and deploy cloud application using popular cloud platforms

CO4. Design Cloud security solutions

Course Contents:

Unit 1:

Introduction to Cloud Computing: Origins and Influences; Basic Concepts and Terminology; Goals and Benefits; Risks and Challenges.

Fundamental Concepts and Models: Roles and Boundaries; Cloud Characteristics; Cloud Delivery Models; Cloud Deployment Models.

Unit 2:

Cloud Enabling Technologies: Broadband Networks and Internet Architecture; Data Center Technology; Virtualization Technology; Web Technology; Multitenant Technology; Service Technology.

Cloud Infrastructure Mechanisms: Logical Network Perimeter; Virtual Server; Cloud Storage Device; Cloud Usage Monitor; Resource Replication; Ready-made environment

Unit 3:

Specialized Cloud Mechanisms: Automated Scaling Listener; Load Balancer; SLA Monitor; Pay-per-use Monitor; Audit Monitor; Failover System; Hypervisor; Resource cluster; Multi-device Broker; State Management Database

Cloud Management Mechanisms: Remote Administration System; Resource Management System; SLA Management System; Billing Management System.

Unit 4:

Cloud Security: Basic Terms and Concepts; Threat Agents; Cloud Security Threats; Additional Considerations.

Cloud Security Mechanisms: Encryption; Hashing; Digital Signature; Public Key Infrastructure; Identity and Access Management; Single-Sign-on; Cloud-based Security Groups; Hardened Virtual Server Images.

Recommended Learning Resources:

1. Thomas Erl , Ricardo Puttini , ZaighamMahmood Cloud Computing: Concepts, Technology & Architecture PHI, 2013.
2. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, Distributed and Cloud Computing,MK,2012.
3. DharanipragadaJanakiram, Grid and Cloud Computing, McGraw-Hill 2016.

References:

1. Dan C. Marinescu, Cloud Computing: Theory and Practice, MK
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. RajkumarBuyya, JamesBroberg, AndrzejGoscinski, Cloud Computing- Principles and Pradigms,Wiley.
4. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Cloud Computing, A practical approach, TATA McGRAW HILL.
5. Gautam Shroff, Enterprise Cloud Computing- Technology, Architecture, Applications, CAMBRIDGE.
6. David Marshall, Wade A. Reynolds and Dave McCrory, Advanced Server Virtualization- VMware and Microsoft Platforms in the Virtual Data Center, AUERBACH Publications.
7. Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.
8. International Journal of Cloud Computing, INDERSCIENCE Publishers.
9. IEEE Cloud Computing
10. International Journal of Cloud Applications and Computing (IJCAC), IGI Global.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	3	3	2	3	1	1	1	1	1	**1**	**3**	**3**	**2**
CO2	2	3	3	2	3	1	1	1	1	1	**1**	**3**	**3**	**2**
CO3	2	3	3	2	3	1	1	1	1	1	**1**	**3**	**3**	**2**
CO4	2	3	3	2	3	1	1	1	1	1	**1**	**3**	**3**	**2**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Week)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F1300	Machine Learning and Deep Learning	16	HC	4	1	0	5	6

Prerequisites:

Students must have studied Data Structure, Algorithms and Mathematics

Course Objectives:

The objectives of this course are to:

1. Understand the basic theory underlying machine learning.
2. Illustrate the applications of machine learning algorithms to solve problems of moderate complexity for data analysis.
3. Explain the Neural Network a biologically-inspired programming paradigm which enables a computer to learn from observational data.
4. Impart the knowledge of Deep learning, a powerful set of techniques for learning in Neural Networks.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

CO1:.Design a Learning Model for any real time applications.

CO2: Understand supervised and unsupervised learning

CO3: Perceive how to apply Neural Networks.

C04: Apprehend how to perform evaluation of learning algorithms and Deep Learning.

Course Contents:

Unit-1

Introduction: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues tin Machine Learning Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, and Reinforcement Learning. Supervised Learning. Concept Learning and the General-to-Specific Ordering.

Unit-2

Dimensionality Reduction: Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis. Clustering: Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters. Decision Tree Learning,

Unit-3

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units. Feedforward Neural Networks: Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks,

Unit-4

Deep Feed forward Networks: Example learning XOR, Gradient based learning, Hidden units, Architectural design, Back propagation and other differential algorithms

Recommended Learning Resources:

1. Machine Learning Tom Mitchell: McGraw-Hill Chapters 1, 2, 3, 4, 6, 8, 9.1 to 9.4, 13
2. Introduction to Machine Learning Ethem Alpaydin: Second edition MIT press Chapters 1, 2, 6, 7, 19
3. Artificial Neural Networks B. Yagna Narayana, PHI
4. Deep Learning -Ian Good fellow, Yoshua Bengio and Aaron Courville.An MIT Press book
5. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
6. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
7. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3							**2**	**2**	**1**
CO2	2	3	2	3	3							**3**	**2**	**1**
CO3	3	3	3	3	2							**2**	**2**	**1**
CO4	3	2	3	2	3							**2**	**2**	**1**

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MTCS17F1410	Advanced Web Technologies	16	SC	4	1	0	5	6

Course Objectives:

The objectives of this course are to:

1. Introduce server-side Web technologies.
2. Impart knowledge about the concepts, design and basic coding of advanced Web applications such as ASP, JSP, .NET, Perl, CGI and other server side technologies,
3. Create and revise a multimedia web; integrate basic database functions;
4. Enable publishing to multiple servers, XML, XSLT, SHTML, and Cascading Style Sheets may be utilized.
5. WAP Architecture, WAP stack and emerging technologies on mobile devices.

Course Outcomes:

On successful completion of this course; the student will be able to:

CO 1: Illustrate the fundamentals and advanced concepts in the area of web services

CO 2: Apply servlets Concepts like Servlet classes and Threading to build web applications.

CO 3: Utilize Web Service Architectures to build web services for agriculture applications.

CO 4: Outline various WAP Applications used in medical system.

Course Contents:

Unit- 1

Introduction: The World Wide Web, WWW Architecture, Web Search Engines, Web crawling, Web indexing, Web Searching, Search engines optimization and limitations, Introduction to the semantic web.

Unit- 2

Servlets: Introduction to servlets, Servlet life Cycle, Servlet classes, Threading Models Http Sessions.

Unit- 3

Introduction to web services: What is a Web Service? Software as a service, Web Service Architectures, SOA, XML,

Unit 4

Limitations of Mobile Devices WAP Architecture , WAP stack. Online Applications and emerging technologies , Online Shopping , Online databases , Monitoring user events , Need for NET ,Overview of NET Framework , Web services.

Recommended Learning Resources:

1. Robert W. Sebesta, Programming the World Wide Web, Pearson Education 2008.
2. Web warrier guide to web programming, Bai,Hue, others, Thomson/Course Technology, 2003
3. Internet and World Wide Web How To Program, Deitel P, Deitel HM, Pearson Education, 2012
4. AchyutS. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.
5. Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.
6. Paul S Wang, SandaKatila An introduction to Web design and programming Cengage Course, 2003.
7. ACM Trans on Internet Technology
8. IEEE International Conference on Enterprise Computing and E-Commerce.
9. ACM Transactions on Information Systems.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	1	2	**1**						**3**	**3**	**2**
CO2	2	3	2	2	3	**1**						**3**	**3**	**2**
CO3	2	3	3	3	3	**1**						**3**	**3**	**2**
CO4	2	3	2	2	3	**1**						**3**	**3**	**2**

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
MTCS17F1420	**Advanced Storage Area Networks**	**16**	**SC**	**4**	**1**	**0**	**5**	**6**

Course Objectives:

The Objective of this course is to provide an understanding of the need for SAN, caching, local file systems, SAN hardware, and SAN Architecture on going through this course.

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Identify the need for performance evaluation and the metrics used for it
2. Apply the techniques used for data maintenance.
3. Realize storage virtualization concept
4. Develop techniques for evaluating policies for LUN masking, file systems

Course Contents:

Unit 1:
Server Centric IT Architecture and its Limitations; Storage: Centric IT Architecture and its advantages; Case study: Replacing a server with Storage Networks; The Data Storage and Data Access problem; The Battle for size and access. Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID and different RAID levels;

Unit2:
Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems; Availability of disk subsystems. The Physical I/O path from the CPU to the Storage System; SCSI.

Fiber Channel Protocol Stack; Fiber Channel SAN; IP Storage The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system.

Unit 3:
Local File Systems: Network file Systems and file servers; Shared Disk file systems; Comparison of fiber Channel and NAS, Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network

Unit 4:
Overview, creating a Network for storage: SAN Hardware devices, the fiber channel switch, Host Bus adaptors; putting the storage in SAN; Fabric operation from a Hardware perspective. The switch's Operating system, Device Drivers, The Supporting the switch's components, Configuration options for SANs. Panning for business continuity.

Recommended learning resources:

1. U. Troppens, R. Erkens and W. Muller, *Storage Networks Explained*, John Wiley and Sons, 2003.
2. R. Spalding, *Storage Networks: The Complete Reference*, Tata McGraw Hill, 2003.
3. R. Barker and P. Massiglia, *Storage Area Network Essentials: A Complete Guide to understanding and Implementing SANs*, John Wiley India, 2002.
4. M. Farley, *Storage Networking Fundamentals*, Cisco Press, 2005.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	3	2	2	3	1							3	
CO2	3	2	1	3	3	2							3	
CO3	1	3	2	2	3	1							3	
CO4	2	1	2	3	3	1							3	

Where, (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MTCS17F1430	Statistical Data Modelling and Analysis	16	SC	4	1	0	5	6

Course Objectives:

The objectives of this course are to:

1. Explore and characterize their data, including defining the mean, median, uncertainties, and factors that contribute to variance.
2. Describe how to propagate errors in calculations of derived quantities and perform formal hypothesis testing in interpreting data.
3. Make Use of basic concepts of linear algebra and least squares formalism for curve fitting and regression.
4. Explore various ways to examine sequential or time-series data, including using spectral analysis.

Course Outcomes:

On successful completion of this course; the student will be able to:

CO1: Apply technical knowledge of mathematics and physics to solve real-world computer applications in geology and geophysics

CO2: Describe the propagation of errors in calculations of derived quantities and perform formal hypothesis testing in interpreting data.

CO3: Make use of scientific method to define, analyse, and solve a problem in earth science.

CO4: communicate scientific knowledge in both oral presentations and in writing

Course Contents:

Unit- 1

Exploring Data & Error Analysis; Classification of data, exploratory data analysis, Error Analysis; Reporting uncertainties, significant figures, & errors of sums & general functions, Uncertainties of products, quotients, and examples.

Basic Concepts in Statistics ; Probability Basics, Permutations, Combinations, Binomial probability distribution, Hyper geometric distribution, Some Rules of Probability, Additional rules, Conditional Probability, Conditional Probability and Bayes Theorem

M&M's of Statistics; Population and Samples, Measure of central location (mean, median, mode), Probability Distributions and Inference about the mean and Central Limits Theorem Probability

Distributions, Binomial and Normal Distributions, The Normal (Gaussian) Probability Density Function, Applications of the Normal Distribution & the Poisson's Distribution, Inferences about means of populations.

Unit- 2
Hypothesis Testing; Null Hypothesis, Videos, Parametric Tests (Students t, Chi-squared, F tests), One and two sample test of means Tables: normal distribution, t-distribution, chi-squared, F-distribution

Non-Parametric Tests; Parametric vs. Non-Parametric tests, Sign test of central value, Mann-Whitney 2-sample U test of median, Tables: Mann-Whitney, K-S (1-sample), K-S (2-sample).

Unit- 3
Regression; Line Fitting Revisited, Confidence Intervals on True Slope, Intercept, and Regression Line, Derivation of Variances of True Slope, Intercept, and Regression Line.

Analysis of Variance (ANOVA); Analysis of Variance (ANOVA) of Linear Regression, ANOVA, One-way ANOVA, Two-way ANOVA.

Unit 4
Sequences and Time Series Analysis; Markov Chains, Auto correlation, with data for auto- and cross-correlation, Autocorrelation and Cross-Correlation.

Spectral Analysis; Spectral Analysis: Basic Terminology, Introduction to spectral analysis, Orthogonally of periodic functions, Spectral Analysis. Spectral Analysis: Fitting the Fourier Series, Periodogram or Discrete Power Spectrum.

Recommended Learning Resources:

1. Introduction to Statistics and Data Analysis, by Paul Wessel. Recommended (optional) text: John C. Davis, Statistics and Data Analysis in Geology, 3rd Edition
2. A Abebe, J Daniels, et al., Statistics and Data Analysis.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	2							3		
CO2	3	3	3	2	2	1							2	
CO3	3	2	2	2	3									3
CO4	3	3	3	2	2	2	2						2	

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F1510	**Image Processing**	**16**	**SC**	**4**	**1**	**0**	**5**	**6**

Course Objectives

The objectives of this course are to:

1. Discuss the image fundamentals and mathematical transforms necessary for image processing.
2. Discuss the different Image restoration methods.
3. Analyze Image enhancement in both the spatial and frequency domains.
4. To analyze the constraints in image processing when dealing with 3D data sets.

Course Outcomes

On successful completion of this course, the student will be able to:

1. Understand image formation and the role human visual system play in perception of gray and color image data.
2. Apply image processing techniques in both the spatial and frequency domains.
3. Conduct independent study and analysis of feature extraction techniques.
4. Demonstrate color Fundamentals in color image processing.

Course Contents

Unit- 1

INTRODUCTION TO IMAGE PROCESSING: What is Digital Image Processing, Origins of Digital Image Processing, examples of fields that use DIP, Fundamental Steps in Digital Image Processing and Components of an Image Processing system. Digital Image Fundamentals: Elements of Visual Perception, Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images.

Unit- 2

IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters.

Unit- 3

IMAGE RESTORATION: A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering.

Unit-4

COLOR FUNDAMENTALS AND IMAGE COMPRESSION: Color Models, Pseudocolour Image Processing, Basics of Full Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Fundamentals ,Some basic methods: Huffman coding, Arithmetic coding, Symbol-based coding, Bit- plane coding, Predictive coding, Digital image watermarking

Recommended Learning Resources

1. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, PHI 2nd Edition 2005

2. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004.

3. Scott.E.Umbaugh: Digital Image Processing and Analysis, CRC Press, 2014.

4. S.Jayaraman, S.Esakkirajan, T.Veerakumar: Digital Image Processing, McGraw Hill, 2013.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	1	2							2	2	2
CO2	2	3	3	3	2							1		
CO3	2	2	2	3	3							1	1	
CO4	3	3	3	3	3							3	2	2

Where, (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
MTCS17F1520	**Mobile Application Development**	16	SC	4	1	0	5	6

Prerequisite:

Basic Programming Language

Course Objectives:

The objectives of this course are to:

1. Analyze system requirements for mobile applications.
2. Apply of mobile development frameworks.
3. Demonstrate mobile application design.
4. Demonstrate and implement mobile application.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Describe the requirements for mobile applications
2. Explain the challenges in mobile application design and development
3. Develop design for mobile applications for specific requirements
4. Implement the design using Android SDK
5. Implement the design using Objective C and iOS
6. Deploy mobile applications in Android and iPone marketplace for distribution

Course Contents:

Unit-1:

Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.

Unit-2:

Fundamentals of Android Development: Introduction to Android., The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator.

Unit-3:

The Intent of Android Development, Four kinds of Android Components: Activity, Service, Broadcast Receiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API.

Unit-4:

Creating the Activity, Working with views: Exploring common views, using a list view, creating custom views, understanding layout. Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments. Multimedia: Playing Audio, Playing Video and Capturing Media. Advanced Android Programming: Internet, Entertainment, and Services.

Recommended Learning Resources:

1. Mobile Computing: technologies and Applications-N. N. Jani S Chand
2. B. M. Hirwani- Android programming Pearson publications-2013
3. W. Frank Ableson, Robi Sen and C. E. Ortiz - Android in Action, Third Edition-2012 DreamTech publisher
4. IJIM, International Journal of Interactive Mobile Technologies

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	1	1		1	2	**2**	**1**	**3**	**1**	**3**
CO2	3	3	2	3	2	2		2	3	**2**	**1**	**3**	**3**	**3**
CO3	1	2	3	1	2	1		1	3	**2**	**2**	**3**	**3**	**2**
CO4	3	3	3	2	2	1		2	2	**2**	**1**	**3**	**2**	**3**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Cours e Type	L	T	P	C	Hrs. /Wk.
MTCS17F1530	**Agile Software Development**	**16**	**SC**	**4**	**1**	**0**	**5**	**6**

Prerequisite:

Software Engineering

Course Objectives:

The objectives of this course are to:

1. Describe the approaches, advantages, and disadvantages of both traditional and agile project methodologies; assess the stakeholder environment and tailor the deliverables accordingly.
2. Explain an agile project management plan that includes the typical steps, activities, and participant roles for an agile project, and evaluate how and when these agile characteristics can beintegrated with steps from a traditional project management life cycle to achieve an effective hybrid approach.
3. Discuss the appropriate tools and resources for agile projects, including specific and adapted metrics that can assist the project manager in defining, executing, and controlling projects that follow an agile, or hybrid, lifecycle and methodology.
4. Understand the core principles, practices that are part of a DevOps implementation and culture.
5. Understand the enormous benefits that organizations would gain by implementing DevOps practices and culture.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Explain and justify the need for agile project management methodologies.
2. Compare and contrast the benefits/costs of agile versus traditional project management methodologies.
3. Assess, plan, deliver, confirm, and track agile project value.
4. Apply tools and techniques to engage stakeholders and keep them interested throughout the project.
5. Define, initiate, plan, execute, monitor/control, and close and agile project by engaging in a simulation using the Scrum methodology.
6. Deepen their knowledge, achieve a mutual understanding for the DevOps framework and strengthen their social competencies in collaboration and improvement.

Course Contents:

Unit-1:

Introduction: Iterative Development, Risk-Driven and Client-Driven Iterative Planning,Time boxed Iterative Development, Evolutionary and Adaptive Development, Evolutionary Requirements Analysis, Early “Top Ten” High-Level Requirements and Skillful Analysis, Evolutionary and Adaptive Planning. Incremental Delivery, Evolutionary Delivery.

Unit-2:

Agile: Agile Development, Classification of Methods, The Agile Manifesto and Principles, Agile Project Management, Embrace Communication and Feedback, Programming as If People Mattered, Simple Practices and Project Tools, Empirical vs. Defined & Prescriptive Process, Principle-Based versus Rule- Based. Sustainable Discipline: The Human Touch, Team as a Complex Adaptive System, Agile Hype? Specific Agile Methods.

Unit-3:

Motivation: The Facts of Change on Software Projects, Key Motivations for Iterative Development, Meeting the Requirements Challenge Iteratively, Problems with the Waterfall.
Evidence: Research Evidence, Early Historical Project Evidence, Standards-Body Evidence, Expert and Thought Leader Evidence, Business Case for Iterative Development.

Unit-4:
Fundamentals : Beginning DevOps for Developers, Introducing DevOps, Building Blocks of DevOps.
Metrics and Measurement View : Quality and Testing, Process view.
Technical View : Automatic Releasing, Infrastructure as Code, Specification by Example.

Recommended Learning Resources:

1. Craig Larman;*Agile and Iterative Development: A Manager's Guide*. Pearson Education; 2003.
2. Robert Cecil Martin;*Agile Software Development: Principles, Patterns, and Practices*; Prentice Hall PTR, Upper Saddle River, NJ, USA; 2003.
3. Michael Huttermann; DevOps for Developers, Integrate Development and Operations, The Agile Way, Apress Publications. (https://books.google.co.in/)

References:

1 IEEE, The IEEE Transactions on Smart Grid
2 Elsevier, e-book on Agile Development and Business Goals

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	2	2							**2**	**3**	
CO2	3	2	2	3	3							**2**	**3**	
CO3	3	-	3	3	2							**2**	**3**	
CO4	3	2	3	3	2							**2**	**3**	

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C		Hrs. /Wk.
MTCS17F 1610	Python Programming	16	SC	4	1	0	5		6

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Course Objectives:

The objectives of this course are to:

1. Discuss scripting tools – Groovi, NodeJs, AngularJS
2. Implement basic programs in Python programming.
3. Explain python lexical features and syntax of python structures and flow control
4. Illustrate the use of python functions files and exceptions

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Explain the potential of scripting technologies in building cutting edge web based systems
2. Analyze and model requirements and constraints for the purpose of designing and implementing software systems in Python;
3. Design and implement Python software solutions that accommodate specified requirements and constraints, based on analysis or modeling or requirements specification.
4. Design and develop GUIs in Python

Course Contents:

Unit- 1

Introduction to Scripting – Difference between scripting and programming languages, Basics of Groovy –Basic Syntax, Datatypes, Variables, Operators, Loops, Decision Making. Basics of NodeJs- What is nodeJs, Features, Uses, NodeJS local environment setup, installation, first nodejs application, Basics of Angular JS –Features, Advantages, Directives, Environment, First application.

Unit-2

Getting started: Introducing python, setting up python on windows and other operating systems, introducing IDLE. Data types, variables, assignment operators, expressions; basic I/O, using quotes with strings, using escape sequences with strings, concatenating and repeating strings, working with numbers, user input, right types, converting values. Branching, using the if, else, else-if statements, Creating and running Python source files (.py)

Unit -3

For loops, strings and tuples: while loops, using for loops, values as conditions, compound conditions, using sequence operators and functions with strings, indexing strings, string immutability, building a new string, slicing strings, tuples. Lists and dictionaries – using Lists, list methods, understanding when to use tuples and lists, nested sequences, shared references, dictionaries, hangman game. Functions, creating functions, parameters and return values, keyword arguments, default parameters, global variables, tic-tac toe game.

Unit- 4

Files and Exceptions: reading and writing to text files, storing complex data, handling exceptions. Software objects, caretaker program, object oriented basics, creating classes, methods and objects, constructors, attributes, class attributes.

GUI development -understanding event driven programming, root window, labels, buttons, creating a GUI using a class, binding widgets and event handlers, text and entry widgets and Grid layout manager, check buttons, radio buttons, creating a graphics window.

Recommended Learning Resources:

1. Python Programming for absolute beginners, Michael Dawson, 3rd Edition, Course technology PTR, 2010.
2. Learn Python the Hard Way, Zed D Shaw, 3rd Edition, Addison Wesley
3. Learning to Program with Python, Richard L. Halterman,2011
4. Mark Lutz , Python Programming, Shroff Publishers & Distributors, 2011
5. Programming Groovy 2: Dynamic Productivity for the Java Developer Book by Venkat Subramaniam, Oreilly Media
6. Node.js, MongoDB and AngularJS Web Development Book by Brad Dayley
7. Web Site Link : https://www.python.org/
8. http://python.berkeley.edu/resources/
9. https://learnpythonthehardway.org/

Suggested Programming Exercises:

1. Output 3-letter month name given the month number using strings;
2. Convert a date in the d/m/y format (d, m and y are day month and year respectively as numbers) to a given (fixed) format;
3. Take the principal amount and the term of a loan and print the EMI.
4. Convert a number in words to numeric.
5. Random Number Generator.
6. Binary Search;
7. Simulate a queue;
8. Find the average of all the input numbers until a prompt;
9. Invert a string;
10. Find the square root of a number using Newtons method where the iterative formula is given;
11. Convert roman numerals to decimal and vice versa;
12. Answer simple questions with a fixed structure (e.g. Is the dolphin a mammal?) using an associative list as a "database" of animals with their classification
13. Solve the Koenigsburg Problem on graphs;
14. Write a decoder for a text that has been encrypted using a Caesar cypher.
15. Creating a Unix-style find with parameters acting as filters on the file attributes.
16. Simple transliteration of an Indian language text into another Indian language; Simple Natural Language Interface to the Unix file system.
17. Complete the compression and extraction programs based on Huffman code.
18. Implement a naive RSA encryption-decryption.
19. Operations on sparse matrices.
20. Make a bouncing balls program draws a set of "walls" of arbitrary sizes and orientations and creates a few (1-3) balls with randomly chosen initial velocities and let them bounce around in a manner consistent with the physical laws of motion.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3			1				1	3	3
CO2	3	2	3	3	2			1				1	3	2
CO3	3	3	3	3	3			1				2	3	3
CO4	3	3	2	3	3			1				2	3	3

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MTCS17F1620	**Robotics**	**16**	SC	4	1	0	5	6

Prerequisite

Coding algorithms, Electronics circuitry, control systems

Course Objectives

The objectives of this course are to:

1. Discuss the fundamentals of Robotics.
2. Explain intelligent module for robotic motion control.
3. Demonstrate robotic vision system using transformation techniques.
4. Illustrate the working of innovative robotic devices.

Course Outcomes

On successful completion of this course, the student will be able to:

1. Outline the fundamentals and architecture of robotics.
2. Design an Intelligent module for robotic motion control.
3. Develop robotic vision system using transformation techniques and sensors.
4. Make use of innovative robotic devices for industrial and socially relevant applications.

Course Contents

Unit 1: Basic Concepts of Robotics:
Introduction, Advantages and Applications of Robots, Basic structure of robots, Numerical controls Machine tools, Resolution, accuracy and Repeatability, Position representation, Specifications of Robot, Speed of Robot-Robot joints and links, Robot classifications

Unit 2: Controls and End Effectors
Control system concepts – Analysis, control of joints, Adaptive and optimal control – End effectors , classification , Mechanical , Magnetic ,Vacuum , Adhesive , Drive systems and controls, Force analysis

and Gripper design.

Unit III-Robot Transformations and Sensors

Robot kinematics-Types- 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems.

Sensors in robot – Touch sensors, tactile sensor, Proximity and range sensors – Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

Unit IV Robot Cell Design and Applications

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, NXT Software Introductions-Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

Micro/Nano Robotics System: Micro/Nanorobotics system overview-Scaling effect-Top down and bottom up approach- Actuators of Micro/Nano robotics system

Recommended Learning Resources

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2. Koren, Yoram,. Robotics for engineers. Vol. 168. New York et al: McGraw-Hill, 1985.
3. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000
4. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
5. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill, Publishing Co., Ltd., 1994.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2							**2**	**3**	**2**
CO2	3	3	3	3	3							**2**	**3**	**2**
CO3	3	3	3	3	3							**2**	**3**	**2**
CO4	3	3	3	2	2							**2**	**3**	**2**

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MTCS17F1630	**Advanced Data Structures**	**16**	**SC**	**4**	**1**	**0**	**5**	**6**

Prerequisites

Concept of Dynamic Memory Allocation, Algorithm Specification, Any one procedure oriented-Programming Language and basic Engineering Mathematics

Course Objectives

The objectives of this course are to:

1. Discuss the basic topics Arrays , Structures, Multiple stacks and queues.
2. Implement linked lists, Trees and graphs in any programming Language.
3. Design and implementation of priority queues and search trees
4. Compare and contrast various data structures for various applications

Course Outcomes

On successful completion of this course; the student will be able to:

1. Design trees, balanced trees, hash sets, and graph structures.
2. Apply various data structures depending on the application at hand.
3. Comprehend the significance of data structures in the design of algorithms.
4. Implement and Analyze concurrent linked lists, stacks, and queues.

Course Contents

Unit- 1
ARRAYS and STRUCTURES: Arrays, Dynamically Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Representation of Multidimensional Arrays Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues.

Unit- 2
LINKED LISTS: Singly Linked lists and Chains, Representing Chains, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists

Unit- 3
TREES & GRAPHS: Introduction, Trees, Binary Trees, Properties and representation of binary trees, Common binary tree operations, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Representation of Disjoint Sets, Counting Binary Trees, The Graph Abstract Data Type, Dictionaries, Linear representation, Skip list presentation, Hash table representation.

Unit- 4

PRIORITY QUEUES & SEARCH TREES: Single- and Double-Ended Priority Queues, Leftist Trees, Binomial Heaps, Fibonacci Heaps, Pairing Heaps. Efficient Binary Search Trees, Optimal Binary Search Trees, AVL Trees, Red-Black Trees, Splay Trees.

Recommended Learning Resources

1. Horowitz, Sahni, Anderson-Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2007.

2.Data structures, Algorithms, and applications in C++ - SartajSahni, McGraw Hill, 2000.

3. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.

4. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009.

5. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, Cengage Learning, 2005.

6. Journal of Experimental Algorithmics (JEA)

7. ACM Transactions on Algorithms (TALG)

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2							**3**	**3**	**2**
CO2	3	2	3	3	3							**2**	**3**	**2**
CO3	3	2	3	3	3							**3**	**3**	**2**
CO4	3	3	3	2	2							**3**	**3**	**2**

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Second Semester

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2100	**Principles of Algorithm Design**	**16**	**HC**	**4**	**0**	**1**	**5**	**6**

Course Objectives:

The objectives of this course are to:

1. Provide a solid foundation in algorithm design and analysis;
2. Analyze the asymptotic performance of algorithms.
3. Apply important algorithmic design paradigms and methods of analysis.
4. Synthesize efficient algorithms in common engineering design situations.

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate, and analyze them.
2. Design and deploy various Polynomials, FFT, Probabilistic and randomized algorithms;
3. Analyze worst-case running times of algorithms using asymptotic analysis;
4. Prove the correctness of algorithms using inductive proofs and invariants;
5. Analyze randomized algorithms with respect to expected running time, probability of error using tail inequalities;
6. Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms;
7. Design and Implementation of algorithms in C, C++.
8. Gain a good understanding on a wide range of advanced algorithmic problems,

   their Relations and variants, and application to real-world problems.

Course Contents:

UNIT – 1

Review of Fundamentals: Algorithms from Ancient to Modern Times – Toward a modern Theory of Algorithms – Computing in the Third Millennium – Guidelines for Algorithm Design – Recursion – Data Structures and Algorithm Design – Major Design Strategies – Analyzing Algorithm Performance – Designing and Analyzing some basic comparison based list algorithms – Asymptotic behavior of Functions – Asymptotic order formulae for three important series – Recurrence relations forcomplexity – Mathematical induction and proving the correctness of algorithms – Establishing lower bounds for problems.

UNIT – 2

Trees & Applications to Algorithms: Mathematical properties of Binary trees – implementation of trees and forests – Tree traversal – Binary search trees – Priority queues and heaps – Implementing disjoint sets – Shellsort – Bingosort – Radixsort – External sorting

UNIIT – 3

Graph & Network Algorithms: Graphs and Digraphs – Bipartite Matching – Maximum flow problem – Ford-Fulkerson Algorithm – Maximum Flows and Minimum Cuts in Network – Choosing Good Augmenting Paths – Preflow-Push Maximum-Flow Algorithm – Bipartite matching problem – Disjoint Paths in directed and undirected graphs – Survey design – Airline Scheduling – Image segmentation – Projection Selection – Baseball Elimination – Adding Costs to the matching problem

UNIT – 4

Extending the Limits of Tractability: Finding small vertex covers – Solving NP-Hard problems on Trees – Coloring a set of circular arcs – Tree decompositions of Graphs – Properties of tree decompositions – Dynamic programming over a tree decomposition – Constructing a tree decomposition

Recommended Learning Resources:

1. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson, 2016
2. Kenneth A. Berman, Jerome L. Paul, Algorithms, Cengage Learning, 2008.
3. T. H. Cormen, C. E Leiserson, R. L. Rivest and C Stein, Introduction to Algorithms, 3rd Edition, Prentice- Hall of India, 2010.
4. Anany Levitin, Introduction to the Design & Analysis of Algorithms, Pearson, 2013
5. Ellis Horowitz, SartajSahni, S. Rajasekharan, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2007.
6. J. Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005.
7. V. Aho, J. E. Hopcraft, and J. D. Ullman, Design and Analysis of Algorithms, Addison-Wesley, 1974.
8. ACM Transactions on Algorithms
9. ACM Transactions on Modeling and Computer Simulation (TOMACS)
10. Transactions on Parallel and Distributed Systems

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3								3	2	
CO2	2	3	3	3								2	2	
CO3	3	2	3	2								3	3	2
CO4	2	3	3	2								3	2	

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2200	**Big Data and Analytics using R**	**16**	**HC**	**4**	**0**	**1**	**5**	**6**

Pre-requisites

Probability and Statistics, Programming Language (C/C++/Java), Database Management Systems and Introduction to Data mining.

Course Objectives

The objectives of this course are to:

1. Understand the fundamentals of ‘R’ programming.
2. Explore few statistical methods that can apply for data manipulation andImporting techniques.
3. Discuss different Regression techniques.
4. Illustrate the working of clustering algorithms using R.

Course Outcomes

On successful completion of this course; the student will be able to:

1. Explain the fundamentals of R Programming Language.
2. Apply and compare basic machine learning techniques using R for data analytics.
3. Design and Implement algorithms to learn Regression techniques for data analysis.
4. Perform analytics and build models for real world data science problems.

Course Contents

Unit - 1
A brief introduction to R: An overview of R, Vectors, factors, and univariate time series, Data frames and matrices, Functions, operators, and loops. Styles of data analysis: Revealing views of the data, Data summary, Statistical analysis questions, aims, and strategies.

Unit - 2
Statistical models: Statistical models, Distributions; models for the random component, Simulation of random numbers and random samples. A review of inference concepts: Basic concepts of estimation, Confidence intervals and tests of hypotheses, Contingency tables, Re-sampling methods for standard errors, tests, and confidence intervals, Theories of inference.

Unit - 3
Regression with a single predictor: Fitting a line to data, Outliers, influence, and robust regression, Standard errors, and confidence intervals, Assessing predictive accuracy. Multiple linear regression; Basic ideas: a book Weight example, the interpretation of model coefficients, multiple regression assumptions, diagnostics, and efficacy measures, A strategy for fitting multiple regression models.

Unit - 4

Logistic Regression: Building a Linear Model for Binary Response Data, Interpretation of the Regression Coefficients in a Logistic Regression Model, Statistical Inference, Classification of New Cases, Estimation in R. Binary Classification, Probabilities, and Evaluating Classification Performance: Binary Classification, Using Probabilities to Make Decisions, Sensitivity and Specificity, Example: German Credit Data, Clustering: k-Means Clustering, Another Way to Look at Clustering: Applying the Expectation-Maximization (EM) Algorithm to Mixtures of Normal Distributions, Hierarchical Clustering Procedures.

Lab Experiments:

1. a. Vectors are the most basic R data objects and there are six types of atomic vectors. They are double, complex, character and raw. Write a program in R to demonstrate the use of Vector objects.

   b. Factors are the data objects which are used to categorize the data and store it as levels. They can store both strings and integers. They are useful in the columns which have a limited number of unique values. Like "Male, "Female" and True, False etc. They are useful in data analysis for statistical modelling Write a program in R to demonstrate the use of Factor Objects.

   c . A data frame is a table or a two dimensional array like structure in which each column contains values of one variable and each row contains one set of values from each column.

   Following are the characteristics of a data frame.
   - The column names should be non-empty.
   - The row names should be unique.
   - The data stored in a data frame can be of numeric, factor or character type.
   - Each column should contain same number of data items.

   Write a program in R to demonstrate the use of Data frame Objects

   d. Matrices are the R objects in which the elements are arranged in a two dimensional rectangular layout. They contain elements of the same atomic types. Though we can create a matrix containing only characters or only logical values, they are not of much use. We use matrices ontaining numeric elements to be used in mathematical calculations.

2. Write a program in R to demonstrate the use of Data frame Objects

3. Write a program in R which performs addition, subtraction, multiplication and division of two vectors.

4. Create a Comma Separated Values file consisting of the following details: Employee ID, Employee Name, Employee Phone Number, Address, Salary Display the input as Data Frames and also print the maximum salary within the input CSV.

5. Predict weight of a person with the person's height known using a linear regression. Use lm() to create a relationship model. Also, find the coefficients from the model created. Get a summary of the relationship model to obtain the average error in prediction.

6. Create a dataset "mtcars" available in the R environment. It gives a comparison betweendifferent car models in terms of mileage per gallon (mpg), cylinder, displacement ("disp"), horsepower ("hp"), weight of the car("wt") and some more parameters. Create a regression equationto predict the mileage of a car given the disp, hp and wt.

7. Consider the annual rainfall details at a place starting from January 2012. Create an R time series object for a period of 12 months and plot it. Further, plot multiple time series within a single graph.

8. Use the R in-built data set named readingSkills to create a decision tree. It describes the score of someone's readingSkills if we know the variables "age", "shoesize", "score" and whether the person is a native speaker or not. Create a decision tree to show which age group and shoesize group is considered as a native speaker?

9. Use the same dataset readingSkills as above mentioned and identify what categorizes as a native speaker using Random Forests by creating 500 trees.

10. The iris dataset contains data about sepal length, sepal width, petal length, and petal width of flowers of different species. Knowing that there are a total of three species of flowers, perform k – Means clustering with value of "k" as 3 in order to create three clusters.

Recommended Learning Resources

1. John Maindonald, W. John Braun, "Data Analysis and Graphics Using R – an Example Based Approach", 3rd Edition, Cambridge University Press, 2010. (Chapters 1.1 – 1.4, 2.1 -2.3, 3.1 - 3.3, 4.1 -4.3, 5.1 – 5.4, 6.1 -6.4)
2. Johannes Ledolter, "DATA MINING AND BUSINESS ANALYTICS WITH R", WILEY, 2013. (Chapters 7, 8 and 15)
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", Notes on R: A Programming Environment for Data Analysis and Graphics Version 3.2.4 (2016-03-10)
4. Roger D. Peng, "R Programming for Data Science", Leanpub, 2015
5. Springer, International Journal of Data Science and Analytics.
6. Elsevier, Computational Statistics & Data Analysis
7. IEEE, Transactions on Big Data.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2							**3**	**2**	**2**
CO2	3	3	2	3	2							**3**	**3**	**2**
CO3	3	2	3	2	2							**3**	**3**	**2**
CO4	2	3	3	2	2							**3**	**2**	**2**

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ WK.
MTCS17F2300	**Internet Of Things**	**16**	**HC**	**4**	1	**0**	**5**	**6**

Prerequisite:

Programming knowledge in C Language; Basic knowledge of Electronics and Logic Design

Course Objectives

The objectives of this course are to:

1. Provide knowledge about the basics of embedded systems and embedded system design
2. Describe Internet-of-Things and design principles
3. Explain the ease of prototyping and production, and think of deployment for the community.
4. Give knowledge about internet principles and techniques for writing embedded code

Course Outcomes

On successful completion of this course, the student will be able to:

1. Understand the basic concept of IoT, protocols and different IoT levels for deployment
2. Differentiate between M2M and IoT communication and will be able to understand steps involve IoT design Methodology and basic programming with python.
3. Understand the Raspberry Pi architecture, upload the code on the board and will be able to communicate to Cloud
4. Perform data analytics using different analytics platforms and understand ethics behind the IoT Development

Course Contents

Unit-I

Introduction to Internet of Things: Introduction-Definition & Characteristics of IoT , Physical Design of IoT- Things in IoT , IoT Protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models, IoT Communication APIs , IoT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.

Unit-II

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT

Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System

Unit-III

Logical Design Using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

IoT Physical Devices and End Points: What is and IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming raspberry pi with python, other IoT devices.

Unit-IV

Case Study & advanced IoT Applications: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualizationin IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards

Recommended Learning Resources

1. Internet of Things, A Hands on Approach, by Arshdeep Bahga & Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson
3. Adrian McEwen & Hakim Cassimally: Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication.
4. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	3							**1**	**2**	**3**
CO2	2	1	3	3	2							**1**	**3**	**3**
CO3	3	2	2	3	3							**2**	**3**	**1**
CO4	3	2	2	3	2							**3**	**1**	**3**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2410	Computer Network Engineering	16	SC	4	1	0	5	6

Course Objectives:

The objectives of this course are to:

1. Discuss the fundamental concepts of computer networking;
2. Make students to become Familiar with the basic taxonomy and terminology of the computer networking area;
3. Introduce the students to advanced networking concepts, preparing the student for entry Advanced courses in computer networking;
4. Allow the students to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes:

On successful completion of this course, the student will be able to:

1. Demonstrate the basic computer network technology;
2. Understand and explain Layered architecture;
3. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer;
4. Implement scheduling algorithms to provide end-to-end Quality of sevice;

Course Contents:

Unit- 1
Network Services and Layered Architectures: Applications; Traffic Characterization and Quality of Service; Network Services; High-Performance Networks; Network Elements; Basic Network Mechanisms; Layered Architecture; Open Data Network Model; Network Architectures; Network Bottlenecks.

Unit- 2
The Internet and TCP/IP Networks: Internet, Overview of Internet Protocols, Internet Protocol, TCP and UDP, Internet Success and Limitation, Performance of TCP/IP Networks

Unit- 3
Scheduling: Introduction; Requirements; Fundamental Choices; Scheduling best-effort connections; scheduling guaranteed-service connections.
Flow Control: model; classification; open-loop flow control; closed-loop flow control; Hybrid flow control

Unit- 4
Traffic Management: Introduction ;An economic framework for Traffic management; Traffic models; Traffic classes; Time scales of traffic management ; Renegotiation; Signaling; Admission Control ; Peak-load pricing, capacity planning.

Recommended Learning Resources:

1. S. Keshav, an Engineering Approach to Computer Networking, Pearson Education.
2. Jean Walrand & pravinVaraiya, High performance communication networks, 2nd Edition, Elsevier publishing
3. Andrew S. Tanenbaum, Computer Networks, Fourth Edition, Prentice Hall.
4. ACM Transactions on Networking
5. IEEE Transactions on Networking
6. ACM Transactions on Computer Systems

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	2	2						2	2	2
CO2	2	2	2	2	2	3						3	2	2
CO3	3	2	2	3	3	2						3	2	3
CO4	2	3	3	3	3	2						2	3	2

Where,1 (Low), 2(Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2420	Research Methodology	**16**	**SC**	**4**	**1**	**0**	**5**	**6**

Course Objectives:

The objectives of this course are to:

1. Familiarize the student with the dimensions and methods of research.
2. Orient the student to make an informed choice from the large number of alternative methods and experimental designs available
3. Enable the student to present a good research proposal.
4. Familiarize the student with the nature of research and scientific writing
5. Empower the student with the knowledge and skills they need to undertake a research project, to present a conference paper and to write a scientific article.

Course Outcomes:

On successful completion of this course; student shall be able to:

1. Appraise some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)

Unit - I:

Research Methodology: An Introduction - meaning of research - objectives of research - motivation in research - types of research - research approaches - significance of research -research methods versus methodology - research and scientific method - importance of knowing how research is done - research processes - criteria of good research

Defining research problem: selecting the problem - necessity of defining the problem - techniques involved in defining a problem.

Unit - II:

Research design: meaning of research design - need for research design - features of good design - different research designs - basic principles of experimental design.

Originality in Research: Resources for research - research skills - time management - role of supervisor and scholar - interaction with subject experts.

Thesis Writing: The preliminary pages and the introduction - the literature review - methodology - the data analysis - the conclusions - the references (IEEE format).

Unit – III:

Review of Literature Description: Review of Literature: Significance of review of literature - source for literature: books -journals – proceedings - thesis and dissertations - unpublished items. On-line Searching: Database – SciFinder – Scopus - Science Direct - Searching research articles - Citation Index -

Impact Factor - H-index etc, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

Tools in Research Description: Introduction of analytical tools – Introduction to data analysis - least squares fitting of linear data and non-linear data - exponential type data - logarithmic type data - power function data and polynomials of different orders - plotting and fitting of linear, Non-linear, Gaussian, Polynomial, and Sigmoidal type data - fitting of exponential growth, exponential decay type data - plotting polar graphs - plotting histograms - Y error bars - XY error bars - data masking.

Tools used in Computer Science: MATLAB, NS2/3, C, C++, Java, Web Service, SPSS, SAS, LOTUS, Excel, Latex and Ms Word.

Unit – IV:

Quantitative Techniques: General steps required for quantitative analysis - reliability of the data - classification of errors – accuracy – precision - statistical treatment of random errors - the standard deviation of complete results - error proportion in arithmetic calculations - uncertainty and its use in representing significant digits of results - confidence limits - estimation of detection limit.

LaTeX and Beamer Description: Writing scientific report - structure and components of research report - revision and refining' - writing project proposal - paper writing for international journals, submitting to editors - conference presentation - preparation of effective slides, pictures, graphs - citation styles. Software for detection of Plagiarism. IPR and Patent filing.

Note: Every batch of students comprising maximum of 4 members should define a research problem. Develop solution for the problem. Write a technical paper and publish it in IEEE/reputed conference/jounal.

Recommended Learning Resources:

1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
3. P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
4. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004.
5. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3nd. ed. Sage Publications, 2008.
6. Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd. ed. Indian: PE, 2005.
7. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis,2nd. ed. New Delhi: TMH publishing Co. Ltd., 2005.
8. I. Gregory, Ethics in Research, Continuum, 2005.
9. COLIN NEVILLI , " The complete guide to referencing and avoiding plagiarism" , Second Edition published by Open Up Study Skills.
10. **RUDRA PRATAP** , " Getting Started with MATLAB " , published by Oxford University

Press-2010

11. **TEERAWAT, ISSARIYAKUL, EKRAM, HOSSAIN – 2008 , “Introduction to Network Simulator NS2”**
12. https://www.stir.ac.uk/media/services/registry/quality/**Book**of**Plagiarism**.pdf
13. ceur-ws.org/Vol-706/poster22.pdf
14. https://**books**.google.co.in/**books**?isbn=1446281094
15. www.nalsarpro.org/pl/projects/modelproject2.pdf
16. www.uninova.pt/cam/teaching/SRMT/SRMTunit11.pdf
17. http://matlab_tools.myetang.com/index_e.htm

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**1**	**1**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**1**	**3**	**1**	**1**	**1**	**1**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**2**	**2**	**2**

Where,1 (Low), 2(Medium) and 3(High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2430	Open Source Cloud Computing Tools	16	SC	4	1	0	5	6

Prerequisites:

Computer Networks, Operating System

Course Objectives:

The objective of this course is to:

1. Design and develop the various programming model and applications on private cloud environment.
2. Encourage usage of open source software designed to deploy and manage large networks of virtual machines, as a highly available, highly scalable Infrastructure as a Service (IaaS) cloud computing platform.
3. Understand Usage of Cloud Stack, which is used by a number of service providers to offer public cloud services, and by many companies to provide an on-premises (private) cloud offering, or as part of a hybrid cloud solution.
4. Techniques to manage cloud with an easy to use Web interface, command line tools, and/or a full-featured RESTful API.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

1. Understand different virtualization technique through theoretical concepts and practical training
2. Understand the practical implementation of map reduce application developments on cloud based hadoop framework
3. Become knowledgeable and expertise in cloud application development process
4. Develop and deploy applications on private cloud environment like Eucalyptus and Openneubla

Course Contents:

Unit – 1

INTRODUCTION TO CLOUD COMPUTING AND RESOURCE VIRTUALIZATION

Cloud Computing delivery models and services, Introduction to Virtualization, Layering and virtualization, Virtual machine monitors, Virtual machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case study: Xen, a VMM based on para virtualization

Unit – 2
CLOUD BASED APPLICATION DEVELOPMENT
Amazon Web Services: EC2 instances, Connecting clients to cloud instances through firewalls, Application and transport layer protocols in EC2, Launch and connect EC2 Linux instance, Use S3 in Java, Install Simple Notification Service on Ubuntu, Create EC2 Placement Group and use MPI.

Unit – 3
OPENNEBULA-A CLOUD ON VMWARE VCENTER
Overview of Components and Accounts, Simple Cloud Deployment, Download and Deploy vOne Cloud, Import Existing vCenter, Create a Virtual Data Center, Interfaces, Security and Resource Consumption Control, Guest Configuration, Infrastructure Configuration, Appliance Configuration.

Unit – 4
EUCALYPTUS OPEN-SOURCE PRIVATE CLOUD
Introduction to Eucalyptus, Eucalyptus Overview, Eucalyptus Components, System Requirements, Eucalyptus Installation, Eucalyptus Network Migration and Upgrade, Eucalyptus Upgrade, Euca2ools Standalone Installation, Overview of Euca2ools, Installing Euca2ools, Configuring Euca2ools, EC2 Compatible Commands.

Recommended Learning Resources:

REFERENCES

1. Dan C. Marinescu, "Cloud Computing - Theory and Practice", 1st Edition, Morgan Kaufmann is an imprint of Elsevier, 2013, ISBN :9780124046276.
2. BirisLublinsky, Kevin T. Smith and Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN 13:9788126551071, 2015.
3. The Open Replacement for vCloud - Bring your VMware environment to the Cloud in 5 minutes. http://vonecloud.today/ ,http://docs.vonecloud.com/1.8/
4. Eucalyptus 3.4.2 FastStart Guide. http://docs.hpcloud.com/pdf/static/Eucalyptus_3.4/faststart-guide-3.4.2.pdf
5. Cloud services for your virtual infrastructure, Part 1: Infrastructure-as-a-Service (IaaS) and Eucalyptus. http://www.ibm.com/developerworks/library/os-cloud-virtual1/
6. YohanWadia, "The Eucalyptus Open-Source Private Cloud". Last Accessed on: http://www.cloudbook.net/resources/stories/the-eucalyptus-open-source-privatecloud as on
7. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN-13: 978-0996025508.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3					1	1	1	**3**	**3**	**3**
CO2	3	2	3	3					1	1	1	**3**	**3**	**3**
CO3	3	2	3	3					1	1	1	**3**	**3**	**3**
CO4	3	2	3	3					1	1	1	**3**	**3**	**3**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2510	Unix Operating System and Internals	16	SC	4	1	0	5	6

Prerequisites:

Computer Concepts and C Programming, Computer Organization

Course Objectives:

The objectives of this course are to:

1. Introduce the history ,basics and structure of Operating System
2. Describe process concepts and scheduling techniques
3. Familiarize with physical and virtual memory management techniques
4. Describe UNIX kernel, data structures and internal representation of files in UNIX operating system

Course Outcomes:

On successful completion of this course, student shall be able to:

1. Explain the history, basics and structure of operating systems
2. Implement various process management and scheduling schemes
3. Design and develop memory management techniques
4. Demonstrate the internals of UNIX operating system

Course Contents:

Unit – I:
Operating System Principles: Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure, Virtual machines.

Unit – II:
Process Management: Process concept, process scheduling, Operations on processes, Inter process communication. Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, Scheduling algorithms, Multiple Processor scheduling Thread scheduling.

Unit – III:
Memory Management: Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

Unit – IV:

UNIX kernel and its files: Introduction to Kernel: Architecture of the UNIX operating system, Introduction to system concepts, Kernel data structures, System Administration, Internal representation of Files: Inodes, structure of a regular file, Directories, Conversion of a path Name toan Inode, Super block, Inode assignment to a new file, Allocation of disk blocks, other file types.

Recommended Learning Resources:

1. Abraham Silberschatz, Peter BearGalvin, Greg Gagne ,Operating System Principles, Wiley Asia Student Edition 2009.
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition 2011.
3. Maurice J. Bach ; The Design of the UNIX Operating System; Pearson Education; Prentice Hall of India, 2004.
4. 1.D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill,2002.

1. Charles Crowley; Operating System: A Design-oriented Approach; Irwin Publishing,2002.

2. Gary J. Nutt; Operating Systems: A Modern Perspective; Addison-Wesley, 2011.

3. Springer Transaction for advance in Distributed computing and middleware.

4. IEEE Transaction for Real time operating system.

5. ACM Transaction for embedded operating system.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	3						3	2	2
CO2	2	2	2	3	3	3						2	2	2
CO3	3	2	3	2	2	3						3	2	
CO4	2	3	3	2	2	3							2	

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
MTCS17F2520	Cyber Security	16	SC	4	1	0	5	6

Pre-requisites:

Computer networking

Course Objectives:

The objectives of this course are to:

1. Introduce the concepts of computer network security covering security architecture and services.
2. Describe security encryption algorithms and standards such as DES.
3. Provide the knowledge about Public key Cryptographic Principles and Algorithms.
4. Explain the features of network security applications

Course Outcomes:

On successful completion of this course; student shall be able to:

1. Explain the concepts of computer network security covering security architecture and services.
2. Use security encryption algorithms and standards such as DES for developing applications
3. Implement Public key Cryptographic Algorithms and integrate them with secured data transaction based systems.
4. Demonstrate the features of network security applications

Course Contents:

UNIT – I:

Introduction: The OSI Security Architecture, Security Attacks, Security Services, mechanisms, A model for network security, standards, symmetric encryption principles, Symmetric Block Encryption Algorithms, Data Encryption Standards, Strength of DES, Triple DES, Advanced Encryption Standard.

UNIT – II:

Public-Key Cryptography and Message Authentication: Public key Cryptographic Principles, Public Key Cryptographic Algorithms (RSA, Diffie-Hellman), Approaches to Message Authentication, Secure Hash Functions (SHA-512), Message Authentication Codes, Digital Signatures.

UNIT – III:

Network Security Applications:X.509 Certificate Format, Overview of Kerberos (Key Exchange), PGP- Features of PGP, Key Rings in PGP, S/MIME, IPSec Overview, Intrusion Detection.

UNIT – IV:

Electronic Mail Security: Password Management, Virus and threats, Virus Countermeasures, Firewalls, The Need for Firewalls, Firewall Characteristics, Types of Firewalls.

Recommended Learning Resources:

1. William Stallings, Network Security Essentials Applications and Standards, Fifth edition, Prentice Hall, 2011
2. Behrouz A. Forouzan, Cryptography and Network Security, Mc Graw Hill,2007.
3. William Stallings, Cryptography and Network Security Principles and Practise, Pearson, Sixth edition, 2013
4. Joseph Migga Kizza, Guide to Computer Security, Springer Science & Media Inc., Third edition, 2015
5. Andrew S. Tanenbaum, Computer Networks, Pearson, Fifth edition.
6. Atul Kahate, Cryptography and Network Security, Mc-Graw Hill, 2013.
7. Springer Journal of Cryptographic Engineering , ISSN 2190-8508
8. ACM,ACM- International Journal of Applied Cryptography,ISSN:1753-0563
9. IEEE, IEEE Transactions on Information Forensics and Security.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3							**3**	**3**	**1**
CO2	3	2	3	3	2							**3**	**3**	**2**
CO3	3	3	2	3	3							**3**	**3**	**2**
CO4	3	3	3	3	2							**3**	**3**	**1**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2530	**Advanced Java Programming**	**16**	**SC**	**4**	**1**	**0**	**5**	6

Prerequisites:
Computer Programming Skills and Applications; Data Structures and Algorithms

Course Objectives:

The objectives of this course are to:

1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications)
2. Illustrate the usage of a Java-enabled browser and/or the appletviewer to execute Java applets along with Java Application Programming Interface and Java multi-class programs
3. Design, implement, test, and debug Java applications written using basic concepts such as primitive data types, various operators, control structures, single-subscripted arrays, and Java classes
4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance

Course Outcomes:

On successful completion of this course; student shall be able to:

1. Analyze the principles and concepts of object-oriented programming;
2. Use a Java-enabled browser and/or the applet viewer to execute Java applets
3. Use the Java interpreter to run Java applications
4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design.

Course Contents:

UNIT – I:

Primitive Data Types and Arithmetic: Data, Data Storage, Identifiers, Syntax, Variables and Constants, the Format of a Simple Program, Arithmetic, Operator Precedence, Casting,
Objects: Introduction to Objects, The String Class, The Anatomy of a Simple Program Revisited, The AVI Package, The Window Class, Input to a Dialog Box, Converting Strings to Numbers, Command Line Arguments, Errors

UNIT – II:

Object-Oriented Programming: Abstract Data Type, Constructors, Instance Methods, Class Methods, Scope and Lifetime of Identifiers, Software Development, Object-Oriented Program Design, the AVI Package Revisited
Selection: More AVI Classes, If..else Statement, Nested If Statement, Conditional Expressions, Else if Statements, Boolean Data Type, Switch, Wrapper Classes, Yet another AVI Class!, The This Object.

UNIT – III:

Repetition and One-Dimensional Arrays: Loop Structure, While Loop, Do..while Loop, Increment/Decrement Operators, For Loop, Which Loop?, Arrays Revisited, Declaring and Initializing One-Dimensional Arrays, Using Arrays, Our Last AVI Class: Check Boxes, Formatting Numbers for Output
Advanced Concepts with Classes: Inheritance, An Example of Inheritance, Overriding Superclass Methods,

Polymorphism, Instance of Operator, Shadowed Variables, Inner Classes, Abstract Methods and Classes, Interfaces, Constructors Revisited, Instance Methods Revisited, Object Properties, Comparing Objects, Copying Objects, Passing Objects as Parameters, Garbage Collection and Object Finalization

UNIT – IV:

Exceptions and Streams: Introduction, Exception Classes, Catching an Exception, Catching Multiple Exceptions, Creating Your Own Exception Class, Throwing an Exception, Finally Blocks, Using Exception Handling, Stream Input and Output, The Stream Tokenizer Class, Text File Processing, The FileDialog,

Applets and Threads: Introduction, Applets, Input to Applets, Playing Sounds, Displaying Images, Loading Images, Arrays Revisited, Image Maps, Threads, Animation, Restrictions, Sound andImages with Applications

Recommended Learning Resources:

1. Barry J. Holmes and Daniel T. Joyce, Object-Oriented Programming With Java; Second Edition; Jones And Bartlett Publishers,2000
2. Dale Skrien; Object-Oriented Design Using Java; McGraw-Hill Higher Education; 2009
3. Danny Poo; Object-Oriented Programming and Java; Second Edition; Springer; 2008.
4. Cay Horstmann; Big Java; 2nd Edition ; John Wiley and Sons
5. Herbert Schildt; The Complete Reference Java J2SE; 5th Edition; TMH Publishing Company Ltd, New Delhi
6. H.M. Dietel and P.J. Dietel; Java How to Program; Sixth Edition; Pearson Education/PHI
7. Cay.S. Horstmann and Gary Cornell; Core Java 2, Vol 1, Fundamentals; Seventh Edition; Pearson Education/PHI
8. Cay.S. Horstmann and Gary Cornell; Core Java 2, Vol 2, Advanced Features; Seventh Edition; Pearson Education/PHI
9. Beginning in Java 2 by Iver Horton, Wrox Publications.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	1						**2**	**3**	**2**	**2**
CO2	3	3	3	2	1						**1**	**3**	**1**	**1**
CO3	3	3	3	2	1						**1**	**2**	**2**	**2**
CO4	3	3	3	2	1						**2**	**3**	**3**	**1**

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration	Course	L	T	P	C	Hrs. /Wk.
MTCS17F2610	**Parallel Computing and Programming**	**16**	**SC**	**4**	**1**	**0**	**5**	6

Prerequisites:

Students must have studied Data Structures , Operating Systems and C/ C++ programming language.

Objectives:

The objectives of the course are to:

1) Introduce the basic theory underlying parallel computing.
2) Learn different algorithms for parallel programming
3) Implement Parallel algorithms using OPENMP.

Course Outcomes:

On **successful** completion of this course, the student shall be able to:

1) Recognize about task and data parallel programs.
2) Express common algorithms in a functional style and solve them in parallel.
3) Develop programs that effectively use parallel collections to achieve performance
4) Analysis the program using various Modelling.

Course Contents:

Unit-1: Introduction to parallel computing: Motivating Parallelism, Scope of parallel computing, Parallel Programming Platforms: Implicit parallelism, Limitations of Memory systems performance, Physical organization of parallel platforms, Communications costs in parallel Machines, Routing Mechanisms for interconnection networks, impact of process-processor Mapping and Mapping Techniques.

Unit-2: Principles parallel algorithm design, preliminaries, decomposition techniques characteristics of tasks and interactions, mapping techniques load balancing, parallel algorithm models

Unit-3: Analytical modelling of parallel programs: sources of overhead in parallel programs, performance Metrix for parallel system, the effect of granularity on performance, programming using message passing paradigm

Unit-4: Programming shared address space platforms, Thread basics, why thread, the POSIX thread API, thread creation and termination, synchronization primitives in Pthreads, controlling threads and synchronization attributes, thread cancellation, composite synchronization constructs, openMP

Recommended Learning Resources:

1. Introduction to Parallel Computing by Ananth Grama, George Karypis, Vipin Kumar,

and Anshul Gupta.

2. Parallel programming in C with MPI and OPENMP

Mapping COs with POs (Program outcomes)

	Program Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	1	1	1	1	1	1	3	3	2
CO2	3	3	3	2	2	1	1	1	1	1	1	2	2	3
CO3	3	3	3	3	3	1	1	1	1	1	1	3	3	2
CO4	3	3	2	3	3	1	1	1	1	1	1	3	2	3

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2620	Human Computer Interaction (UI/UX Design)	16	SC	4	1	0	5	6

Course Objectives:

The objectives of the course are to:

1. Describe basic theories, tools and techniques in HCI.
2. Explain the fundamental aspects of designing and evaluating interfaces.
3. Practice a variety of simple methods for evaluating the quality of a user interface.
4. Apply appropriate HCI techniques to design systems that are usable by people.

Course Outcomes:

On successful completion of this course, the student shall be able to:

1. Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.

Course Contents:

Unit – I:

Introduction and the graphical user interface: Importance of user Interface, definition, importance of good design, benefits of good design, a brief history of Screen design, popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user Interface popularity, characteristics-Principles of user interface.

Unit – II: Design process: Human interaction with computers, importance of human characteristics human consideration, human interaction speeds, understanding business junctions.

Unit – III:

Screen Designing: Design goals, screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis presentation, information simply and meaningfully, information retrieval on web, statistical graphics, technological consideration in interface design.

Unit – IV:

Software tools and Interaction Devices: Specification methods, interface, building tools, keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays, drivers.

Recommended Learning Resources:

1. Jenreece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, Wiley
2. Julie A. Jacko, Human Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, Third Edition, CRC Press
3. M.G. Helander T.K. Landauer P.V. Prabhu, Handbook of Human-Computer Interaction, 2nd Edition, Elsevier
4. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	1	2								**3**	**2**	**-**
CO2	2	3	3	2	1							**2**	**2**	**1**
CO3	2	1	2	2								**1**	**-**	**-**
CO4	2	2	2	3								**2**	**-**	**-**

Where, 1(Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F2630	**Embedded Computing Systems**	**16**	**SC**	**4**	**1**	**0**	**5**	6

Prerequisties:

Microprocessors; Microcontrollers; Operating Systems; C programming

Course Objectives:

The objectives of this course are to:

1. Provide knowledge about the basics of embedded systems and embedded system design
2. Describe Internet-of-Things and design principles
3. Explain the ease of prototyping and production, and think of deployment for the community.
4. Gain expertise in integrating sensing, actuation and software

Course Outcomes:

On completion of this course; the student shall be able to:

1. Explain the basics of embedded systems and design embedded systems
2. Design and Develop Internet-of-Things based applications
3. Develop prototypes of Internet-of-Things based applications, and deploy for the usage of thecommunity.
4. Integrate sensing, actuation and software

Course Contents:

Unit – I:
Introduction to Embedded Systems: Introduction, Complex Systems and Microprocessors, Embedded Systems Design Process, Formalism for System design, Design Example: Model Train Controller, RTOS vs OS.

Unit – II:
The Internet of Things: An Overview & Design Principles: The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things? Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

Unit – III:
Thinking About Prototyping and Prototyping Embedded Devices: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community, Electronics, Arduino, Raspberry Pi, Beagle Bone Black, Electric Imp, And other Notable Platforms.

Unit – IV:
Internet Principles and Techniques for Writing Embedded Code: Internet Communications, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols, Memory Management, Performance and Battery Life, Libraries, Debugging, Current challenges in IoT. 85

Recommended Learning Resources:

1. Wayne Wolf; Computers as Components: Principles of Embedded Computing System Design; second Edition; Elsevier; 2008.

2. Adrian McEwen, Hakim Cassimally; Designing the Internet of Things; Wiley; 2014.

3. *Kurose, James F.; Ross, Keith W:* **Computer networking: a top-down approach** 5th ed., international ed.: Boston, Mass.: Pearson, cop. 2010.

4. Olivier Hersent, David Boswarthick, Omar Elloumi: The Internet of Things: Key Applications

and Protocols; Wiley; 2015.

5. Frank Vahid, Tony Givargis: Embedded System Design: A Unified Hardware/Software Introduction; Wiley; 2006.

6. Springer, Design Automation for Embedded Systems
7. IEEE, IEEE Internet of Things Journal

8. Elsevier, Journal of Network and Computer Applications,

9. Elsevier, Computer Law & Security Review

10. ACM, ACM Transactions on Internet Technology (TOIT)

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2							**3**	**3**	**1**
CO2	3	3	3	3	3							**3**	**3**	**2**
CO3	3	3	3	2	3							**3**	**3**	**1**
CO4	3	3	3	3	2							**3**	**2**	

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

II Year Detailed Syllabus

Third Semester

Course Code	**Course Title**	**Duration (Weeks)**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs/ Wk**
MTCS17F3110	**Text & Web Mining**	**16**	**SC**	**3**	**1**	**0**	**4**	**5**

Prerequisites:

Basic Knowledge of Data Structures and Statistics;,Data Mining Concepts;Basic Understanding of HTML Coding;Basic Programming Knowledge;

Course Objectives:

The objectives of this course are to:

1. Explain the basic concepts of Web Data Mining such as Text Pre-Processing, Information Retrieval

Models and Performance Evaluation Measures

2. Illustrate the application of Web Crawling and Structured Data Extraction;

3. Discuss the knowledge about the concepts of Web Usage and Query Log Mining;

4. Demonstrate the concepts of Sentiment Analysis for real world problems.

Course Outcomes:

On successful completion of this course; the student will be able to:

CO1. Make use of the process of Web Mining for formation Retrieval and Text Pre-Processing.

CO2. Develop Web Crawling such as Search Engines, Structured Data Extraction for Web Data Mining.

CO3. Choose the advanced concepts in Web Usage and Query Log Mining in real world problem.

CO4. Apply Sentiment Analysis to classifiy the real web data.

Course Contents:

Unit1 : Web Mining – Information Retrieval and Web Search Introduction: What is World Wide Web? , Web Data Mining: What is Data Mining? What is Web Mining?, Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval. Model: Boolean Model, Information Retrieval Model: Vector Space Model, Evaluation Measures, Text and Web Page Pre-Processing: Stop Words, Stemming, Other Pre-Processing Tasks, Text and Web Page. Pre- Processing: Web Page Pre-Processing, Duplicate Detection Web Search

Unit 2: Web Crawling and Data Extraction Web Crawling – A Basic Crawler Algorithm, Implementation Issues: Fetching, Parsing, Implementation Issues: Stopword Removal and Stemming, Link Extraction and Canonicalization, Spider Traps, Implementation Issues: Page Repository, Concurrency, Crawler Ethics and Conflicts

Some New Developments: Structured Data Extraction: Wrapper Generation – Introduction, Building DOM Trees, Extraction Based on a Single List Page: Flat Data Records – Two Observations About Data Records, Extraction Based on Multiple Pages – Road Runner Algorithm, SAX Parser – Introduction

Unit 3 – Web Usage Mining Web Usage Mining – Introduction: Data Collection and Pre-Processing, Sources and Types of Data, Key Elements of Web Usage Data Pre-Processing Data Modeling for Web Usage Mining, Query Log Mining – Introduction, Data Sources, Characteristics and Challenges, Query Log Mining – Query Log Data Preparation, Query Log Mining – Query Log Data Models, Query Log Mining – Query Log Feature Extraction, Applications

Unit 4 – Sentiment Analysis Sentiment Analysis – Introduction: The Problems of Opinion Mining, Aspect Based Opinion Summary, Document Sentiment Classification – Classification Based on Supervised Learning, Document Sentiment Classification – Classification Based on Unsupervised Learning, Sentence Subjectivity and Sentiment Classification Opinion Lexicon Expansion, Aspect Based Opinion Mining – Aspect Sentiment Classifications, Aspect Based Opinion Mining – Basic Rules of Opinions, Aspect Based Opinion Mining – Aspect Extraction, Opinion Search and Retrieval

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	-	-	-	-	-	-	3	3	3
CO2	2	3	1	2	1	-	-	-	-	-	-	3	3	2
CO3	2	1	1	2	1	-	-	-	-	-	-	3	3	2
CO4	2	2	1	3	2	-	-	-	-	-	-	3	3	2

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

ourse Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MTCS17F3120	Soft Computing	16	SC	3	1	0	4	5

Prerequisite:
Linear algebra, calculus and statistics, as well as programming and some machine learning

Course Objectives:

The objectives of this course are to:

1. Examine the foundations of machine learning and neural networks
2. Illustrate the feasibility of applying a soft computing methodology for solving problems with computational intelligence.
3. apply fuzzy logic to handle uncertainty in engineering problems, genetic algorithms to combinatorial optimization problems, neural networks to pattern classification and regression problems.
4. evaluate and compare solutions with various soft computing approaches for a given problem.

Course Outcomes:

On successful completion of this course; the student will be able to:

1. Understand the theory of neural networks and fuzzy logic systems with different types of learning
2. Identify a possible neuro-fuzzy technique to solve a given task
3. Evaluate the use of these techniques in a research publication Understand Neural Network Concepts and its architecture
4. Implement a simplified algorithm by applying a soft computing methodology for solving problems with computational intelligence

Course Contents:

Unit 1:

Introduction to Soft Computing: Historical Development, Definitions, advantages and disadvantages, solution of complex real life problems

Fuzzy Systems: Fuzzy sets (operations, membership functions), fuzzy relations, fuzzy reasoning (inference, algorithms, implication), fuzzy rule-based computing, fuzzy control (structure of fuzzy controllers, fuzzification, defuzzification, types of fuzzy controllers).

Unit 2:
Neural Networks: basics of the Neural Network, Training Feed-Forward Neural Networks , Beyond Gradient Descent, Convolutional Neural Networks:

Unit 3:

Deep Learning: Embedding and Representation Learning, Models for Sequence Analysis, Deep Reinforcement Learning

Unit 4:
Evolutionary Computing: Evolution in natural and artificial systems, search and optimization, problem representation, Genetic algorithms (selection, genetic operations), other evolutionary methods (Learning classifier systems, Artificial immune systems).

Hybrid Systems: Combining neural networks, fuzzy systems, and evolutionary computing

Recommended Learning Resources:

1. Sinha, N.K. and Gupta, M. M. : “Soft Computing and Intelligent Systems - Theory and Applications”, Academic Press.
2. Buduma, Nikhil, and Nicholas Locascio. *Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms*. " O'Reilly Media, Inc.", 2017.
3. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007. ISBN: 10: 81-265-1075-7.
4. Jang, J-S. R., Sun,C-T, Mizutani, E.: “Neuro–Fuzzy and Soft Computing”, Prentice Hall of India.
5. Klir, G. J. and Yuan, B.: "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall.
6. Tettamanzi, A., Tomassini, M. “Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems”, Springer.
7. Journal on Advances in Abstract Intelligence and Soft Computing
8. Journal of Soft Computing Applications and Intelligent Systems

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	**2**					1	**2**	**2**	**2**
CO2	3	2	2	2	2	**2**					**1**	**2**	**3**	**3**
CO3	3	2	2	2	2	**2**					2	**1**	**1**	**1**
CO4	3	2	2	2	2	**2**					1	**1**	**2**	**2**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./ Wk.
MTCS17F3130	Wireless Networks	16	SC	3	1	0	4	5

Prerequisites:

Knowledge in Computer Networks

Course Objectives:

The objectives of this course are to:
1. Recall the growth of mobile communication under different generation
2. Outline the Wireless migration options
3. Illustrate Wireless Sensor Networks applications and various operating systems used.

4. Demonstrate the Advanced Broadband Wireless Access Technologies

Course Outcomes

On successful completion of this course, student shall be able to:

1. Analyze the generation of mobile communication techniques
2. Compare the wireless migration options
3. Choose the suitable OS for a particular WSN application
4. Distinguish the various broadband wireless access technologies

Course Contents

Unit-I: Introduction

Amazing growth of Mobile Communications – History of First, Second, Third Generation systems, 4G and Beyond, Next Generation Wireless, Basic Network Architecture, Air-Interface Access Technologies, Roaming, Handoff/ Handover, Mobile data, Wi-Fi, Bluetooth, Cable Systems, Wireless Migration

Options, Network Structure, Packet data transport process flow, Simple IP with VPN, Mobile IP with VPN Traffic Forecasts, Build Ahead, Network Dimensioning, Interface design and Transmission Network Considerations, Placement of Nodes and Overall Network Topology

Unit – II: Wireless Sensor Networks

WSN Applications, Sensor and Robots, Reconfigurable Sensor Networks, Wireless Sensor Technology, Introduction to Sensor Node Technology, Overview, Hardware and Software, Sensor Taxonomy, WN Operating Environment, WN Trends, Middleware for Wireless Sensor Networks, WSN Middleware

Principles, Middleware Architecture, Data-Related Functions, Architectures, Existing Middleware, MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive 91Sensor Networks Services), AMF (Adaptive Middleware Framework), DSWare (Data Service Middleware), CLMF (Cluster-Based Lightweight Middleware Framework), MSM (Middleware for Service Monitoring), Em*, Impala, DFuse, Operating Systems for Wireless Sensor Networks, Operating System Design Issues, Examples of Operating Systems, TinyOS, Mate, MagnetOS, SenOS, PicOS

Unit – IV: Vehicular Adhoc Networks Motivation and History of VANETs, Message sets for Vehicular Communications, Cooperative ITS Technologies, DSRC Vehicular Communication Systems, Decentralized congestion control techniques for VANETs, Mobility model for Vehicular Communication, Macroscopic, Mesoscopic and Microscopic, Simulation Tools and Techniques for Vehicular Communications and Applications: Veins, iTETRIS and VSimRTI.

Unit – III: 5G and Beyond: Technology Path, Smart phones and Wireless Broadband Edge Devices (WBED), Software Defined Radio (SDR), Advanced Broadband Wireless Access, Ultra wideband (UWB), Unlicensed Wireless Access (UWA), FOMA and iMODE, WiBRO, FWA, Multimedia (Mobile TV), MediaFLO, T-DMB, DVB-H Digital, MVNO

Recommended Learning Resources:

1. "Wireless Networks – Design & Integration for LTE, EVDO, HSPA and WiMAX", Clint Smith & Daniel Collins, 3rd Edition, McGrow Hill, 2014.
2. "Vehicular ad hoc Networks - Standards, Solutions, and Research", Editors: Campolo, Claudia, Molinaro, Antonella, Scopigno, Riccardo (Eds.), Springer 2015.
3. "Wireless Sensor Networks - Technology, Protocols, and Applications", KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, Wiley Publications.
4. "Wireless Sensor Networks", Edited by C. S. RAGHAVENDRA, KRISHNA M. SIVALINGAM, TAIEB ZNATI, Springer 2011.
5. Springer Journal on Signals & Communications, http://www.springer.com/engineering/signals/journal/11276

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	**2**					1	**2**	**2**	**2**
CO2	3	2	2	2	2	**2**					**1**	**2**	**3**	**3**
CO3	3	2	2	2	2	**2**					2	**1**	**1**	**1**
CO4	3	2	2	2	2	**2**					1	**1**	**2**	**2**

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

A set of certification programs are offered to enable students to acquire various skills apart from the subject knowledge in their respective areas. A Certification after studying a set of courses in a particular field lead to certificate status or a license to practice. Certification proves to you and to potential employers that you have attained certain knowledge of and experience in your field.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs/ Wk.
MTCS17F3200	**Internet Computer and Apllication**	**16**	**OE**	**3**	**1**	**0**	**4**	**5**

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs/ Wk.
MTCS17F3300	**Minor Project/Internship**	**16**	**HC**	**0**	**0**	**2**	**2**	**4**

Project survey has to be completed and problem identification for the project must be done. Students must meet the guide and discuss with due PPT presentations at least two hours per Wk. and do the necessary ground work for Phase II devoting at least 6 hours per week.

FOURTH SEMESTER

Course Code	Course Title	Duration (Weeks)	Course	L	T	P	C	Hrs./
MTCS17F4100	**Project Work and Dissertation**	**16**	**HC**	**2**	**4**	**14**	**20**	**40**

Career Development and Placement

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career

Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Commerce is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care.

The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career.

The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The various skill/certification programs identified are as follows:

- Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX
- Red-hat certified programs on LINUX,

- Management related programs like SAP,ERP and Business Analytics
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration
- IBM certified programs.

The University has signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

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DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbors.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.

2. Healthy suggestions are welcome for betterment of Institution

10 YEARS OF UNIVERSITY RECOGNITION
20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY
Bengaluru, India

School of Electronics & Communication Engineering

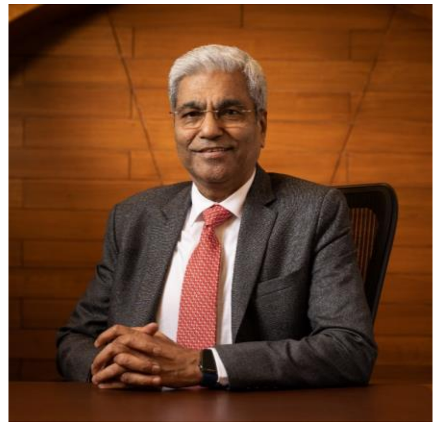
HANDBOOK

M. Tech. VLSI & Embedded Systems (Full-Time)

2017-2019 Batch

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

Chancellor's Message



"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to
empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju
The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor’s Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this ‘temple of learning’ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr.S. Y. Kulkarni

Vice-Chancellor, REVA University

PREFACE

The M. Tech in VLSI and Embedded System is designed keeping in view the current situation and possible future developments, both at national and international levels. This course is designed to give greater emphasis on VLSI and Embedded System design with a flexibility to explore any of the implementation platform and application field through a number of soft core courses providing knowledge in these specialized areas. This facilitates the students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts and requisite skills.

The area of VLSI design has gained enormous popularity over the past few decades due to the rapid advancements in integrated circuit (IC) design and technology. The ability to produce miniaturized circuits with high performance in terms of power and speed is the reason for its popularity. Using ASIC technology, it has been possible to develop high performance multi-core processors. Verification and testing of such complex designs is a critical and challenging task to ensure the quality of the resulting circuits. The advances in EDA software and CAD tools alleviate the effort necessary to carry out the cumbersome design and verification process of ICs.

The program is designed to expose students to various courses having applications in VLSI and Embedded System like Digital VLSI design, ASIC design, SOC design, Low Power VLSI, High Speed VLSI design, VLSI Testing and verification, CMOS RF Circuit design, Low Power Embedded system. They are also exposed to basic concepts of NANO technology, VLSI testing and Verification, fabrication process ,MEMS, Application specific design and embedded platform like ARM, MSP430, low power microcontrollers and FPGA, through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, internships, certification programs, etc. in consultation with industries will be carried out. There is also a scope for cultural, social and community service activities for the students to shape their personality suitable for all-round development.

The VLSI and Embedded System students can choose their career in any VLSI and Embedded System development industries. Now a days almost every appliance is coming with some VLSI component. The scope of VLSI and Embedded System is very wide covering almost every home appliances, industry, automotives, and medical appliance manufactures industry automation and control, telecommunication, **Computer and Digital Systems**, defense and space exploration.

I am sure the students choosing M Tech in VLSI and Embedded System in School of Electronics and Communication Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Prof. Rajashekhar C. Biradar
Director
School of Electronics and Communication Engineering

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 14000+ students studying in various branches of knowledge at graduate and post graduate level and 350 Scholars pursuing research leading to PhD in 21 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano- Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill

Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country.

One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVOTSAVA conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honors and recognitions.

ABOUT SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

The School of Electronics and Communication Engineering headed by a highly experienced Professor and is supported by well qualified faculty members. The school has the state-of-art class rooms and well equipped laboratories. It offers B.Tech and M.Tech and PhD programs in various specialized streams. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry application oriented. The B. Tech program aims to prepare human resources to play a leading role in the continuing adventure of modern automated systems and communications. The Master degree programs focus on research and design in the core and IT industries, building and marketing the next generation of product development. This is reflected in various core subjects offered within the program. B. Tech program offers numerous choices of study for the students based on interest in the current state of art technology. Apart from fundamental courses in Electronics and Communication Engineering, the school facilitates to study in four streams such as Circuits and Devices, Communication Engineering, Signal Processing and Programming. Students are at liberty to choose from these streams in higher semesters. However, there is no restriction of cross migration from one stream to another at any level and thus there is a flexibility provided in the course duration.

The faculty members have number of publications in reputed national and international journals/conferences. The school is also involved in funded research projects. The other important features of the school are individual counseling of students for academic performance, additional coaching classes for important subjects for all the semesters, soft skill development classes, scientific and student centered teaching-learning process.

Student's welfare is given utmost priority at School of Electronics and Communication Engineering. Advanced learning methods are adopted to make learning truly interactive. More focus is on discussion and practical applications rather than rote learning. Notes/handouts are given and critical thinking questions are asked to test understanding. Experienced, well qualified and friendly faculty members always strive hard to provide best of education to students.

Vision

The School of Electronics and Communication Engineering is envisioned to be a leading centre of higher learning with academic excellence in the field of electronics and communication engineering blended by research and innovation in tune with changing technological and cultural challenges supported with leadership qualities, ethical and moral values.

Mission

- Establish a unique learning environment to enable the students to face the challenges of the Electronics and Communication Engineering field.
- Promote the establishment of centers of excellence in niche technology areas to nurture the spirit of innovation and creativity among faculty and students.
- Provide ethical and value based education by promoting activities addressing the societal needs.
- Enable students to develop skills to solve complex technological problems of current times and also provide a framework for promoting collaborative and multidisciplinary activities.

ADVISORY BOARD

Sl. No	Name and Affiliation
1	Dr. M.H.Kori, Technology Consultant, Technology Adviser Validus Technologies USA, Retd. Technical Director, Alcatel-Lucent Technologies, Bengaluru
2	Mr. Vinod Chippalakatti, Vice President, CENTUM Electronics, Bengaluru
3	Dr. Madhusudhna Rao, Group Director & Chief Coordinator (LCA AF), ADA, Bengaluru
4	Dr. Shirshu Varma Professor, Department of Computer Science and Engineering IIIT Allahabad
5	Dr. Rathna G. N. Principal Research Scientist, Department of Electrical Engineering IISc., Bengaluru
6	Mr. Goutham Kumar , Head of Electronics,RLE India
7	Dr. Girish Kumar, Professor, Electrical Engineering, IIT Bombay
8	Dr. Muralidhara Kulkarni Department of Electronics & Communication Engineering, NITK, Surathkal
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10	Dr. Shivashankar, SECE, VIT Vellore
11	Mr.Aravinda Sharma, Manager, Delphi Systems, Bengaluru
12	Dr. Kashinath, Director, ALS Semiconductors, Bengaluru
13	Mr.LokeshaRai K, Director, Symphony Telecca Services, Bengaluru
14	Sanjeev Kubakaddi, Itie Solutions, Bengaluru

Programme Overview

Electronics and Communication Engineering is an engineering discipline involved design, development, manufacture and deployment of Electronic and Communication systems. It deals with electronic devices, circuits, communication equipment like transmitter, receiver, integrated circuits (IC), analog and digital transmission and reception of data, voice and video, microprocessors, satellite communication, microwave engineering, antennae and wave progression. Signal and Image processing, Communication Technologies, Embedded Systems, VLSI Systems are some of the specialized areas available in electronics for further study.

Very Large Scale Integration (VLSI) system design is the process of creating complex integrated circuits by combining million/billion number of transistors into a single chip. This programme aims to prepare the students to design analog and digital integrated circuits using custom and semicustom design flow.

Worldwide, for the past five decades, the semiconductor industry has distinguished itself by the rapid pace of improvement in its products. The improvement of integration level, cost, speed, power, compactness and functionality of the integrated circuits leads to significant improvement in economic productivity and overall quality of life through proliferation of computers, communication, industrial and consumer electronics.

The improvement and complexity of VLSI system can be achieved by revolution of CMOS transistors, miniaturization of transistors, VLSI design methodology, EDA tool support, fabrication support, new design idea and innovative technology which are active research area in VLSI system design.

The ICs/Micro Processor/Micro-Controller/ chips developed and fabricated using VLSI technology become the heart of embedded systems. Embedded systems have become pervasive across various domains such as automotive, industrial and communication systems leading to tremendous growth in the application and innovation of networked and high performance real time embedded systems.

To sustain the growth rate, the organizations involved in VLSI technology and Embedded Systems development are in need of designers, analysts, developers, manufacturing, testing and marketing engineers as well as managers with a postgraduate degree in VLSI design and Embedded System sector.

The **School of Electronics and Communication Engineering at REVA UNIVERSITY** offers M. Tech., in **VLSI and Embedded Systems**–a postgraduate programme to create motivated, innovative, creative and thinking graduates to fill the roles of Electronic Engineers who can conceptualize, design, analyze and develop VLSI and Embedded systems to meet the modern day requirements.

The number of product and service based semiconductor industry are growing, thus various career opportunities exist in product development companies including mobile and consumer electronics, computing, telecommunications, networking, data processing, automotive, healthcare and industrial applications.

In this context**, The School of Electronics and Communication Engineering at REVA UNIVERSITY would like to add to the growing human resources needs of VLSI and Embedded system sector as engineers through its M. Tech. programme in VLSI and Embedded Systems.**

During the programme the theoretical foundation is built through courses like Digital VLSI design, High speed VLSI design, Low power VLSI Design, Analog and mixed mode design, system on chip design. The practice includes skill development in both Front end & Back end designs, verification and testing. The program also offers strong knowledge and practical skills in developing embedded solutions on varied platforms such as FPGA, Advanced microcontrollers and processors. The students learn to implement real time embedded systems. The designers gain practical knowledge through mini and major projects in both VLSI and Embedded system design domains.

Program Educational Objectives (PEO's)

The programme educational objectives of the Electronics and Communication Engineering of REVA University is to prepare graduates

PEO-1	To have successful professional careers in national and multinational organization and communicate effectively as a member of a team orto lead a team.
PEO-2	To continue to learn and advance their careers throughactivities such asresearch and development, acquiring doctoral degree, participation in national level research programmes, teaching and research at university level etc.,
PEO-3	To be active members ready to serve the society locally and internationally, may takeupentrpreneurship for the growth of economy and to generate employment; and adopt the philosopy of lifelong learning to be aligned with economic and technological development.

Program Outcomes (POs)

After successful completion of the programme, the graduates shall be able to

PO1. **Demonstrate in-depth knowledge** of VLSI and Embeded Systems, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2. **Analyze complex engineering problems critically**, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3. **Think laterally and originally, conceptualize and solve engineering problems, evaluate** a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4. **Extract information pertinent to unfamiliar problems through literature survey and experiments**, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5. **Create, select, learn and apply appropriate techniques**, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

PO6. **Possess knowledge and understanding of group dynamics, recognize** opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7**. Demonstrate knowledge and understanding** of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8. **Communicate with the engineering community, and with society at large**, regarding **complex engineering activities** confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: **Recognize the need for**, and have the preparation and ability to engage in **life-long learning** independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10. **Acquire professional and intellectual integrity,** professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11. **Observe and examine critically the outcomes** of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback (**SELF learning**)

Programme Specific Outcomes (PSO's)

After successful completion of the programme, the graduates shall be able to

1. Isolate and solve complex problems in the domains of VLSI and Embedded Systems using latest hardware and software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions either independently or as a team.
2. Implant the capacity to apply the concepts of FPGA, ASIC, System On Chip, IoT and cyber physical systems, etc. in the design, development and implementation of application oriented engineering systems
3. Design, Model, Analyze and VLSI and Embedded Systems to solve real life and industry problems.

M.Tech. (VLSI & Embedded Systems Full Time)
Scheme of Instructions
(effective from Academic Year 2017)

Eligibility: B.E./B. Tech. In ECE/TE/EEE/CSE/ISE/ Instrumentation Technology/ Medical Electronics/ Electrical and Electronics Engineering/ M Sc in Electronics with a minimum of 45% (40% in case of candidates belonging to SC and ST) marks in aggregate of any recognized university/institution or any other qualification recognized as equivalent there to.

Sl No	Course Code	Title of the Course	HC/ SC	Credit Pattern			
				L	T	P	Total
1	MT17VS101	Advanced Mathematics	HC	4	1	0	5
2	MT17VS102	CMOS VLSI Design	HC	4	0	1	5
3	MT17VS103	Advanced Embedded System Design	HC	4	0	1	5
4	MT17VS114	Advanced Digital System Design using Verilog	SC1	4	1	0	5
	MT17VS124	Semiconductor Device Modeling & Technology		4	1	0	5
	MT17VS134	Internet of Things- Practical Approach		4	1	0	5
5	MT17VS115	Unix/Linux Shell Scripting and Python Basics	SC2	4	1	0	5
	MT17VS125	SOC Design		4	1	0	
		Total Credits					**25**
1	MT17VS201	Design of Analog CMOS Integrated Circuits	HC	4	0	1	5
2	MT17VS202	Real Time Operating Systems	HC	4	0	1	5
3	MT17VS213	Low Power VLSI Design	SC3	4	1	0	5
	MT17VS223	VLSI for Signal Processing		4	1	0	
4	MT17VS214	High Speed VLSI Design	SC4	4	1	0	5
	MT17VS224	ASIC Design and Verification using SystemVerilog		4	1	0	
5	MT17VS215	MEMS	SC5	4	1	0	5
	MT17VS225	Advanced Computer Architecture		4	0	1	
		Total Credits					**25**

Sl No	Course Code	Title of the Course	HC/SC	Credit Pattern			
				L	**T**	**P**	**Total**
1	MT17VS301	MOOC / Swayam / Edx / Harvard / CM / Internship/Soft skill training	-	0	0	3	3
2	MT17VS302	Mini Project	HC	0	2	8	10
3	MT17VS303	Sports, Yoga, Music, Dance, Theatre	-	0	0	2	2
3	MT17VS313	MSP430	SC6	4	0	1	5
	MT17VS323	FPGA Based Embedded System Design		4	1	0	
	MT17VS333	Synthesis and optimization of Digital Circuits		4	1	0	
	MT17VS343	CMOS RF Circuit Design		4	1	0	
	MT17VS353	Advances in VLSI Design		4	1	0	
4	MT17VS314	Automotive Electronics System	OE	3	1	0	4
		Total Credits					**24**
FOURTH SEMESTER							
1	MT17VS401	Dissertation	HC	0	2	20	22
		Total Credits					**22**
	Total Credits for four Semesters						**96**

Note: HC = Hard Core: SC= Soft Core;

*For all the courses which are not supported by lab component students have to build mini project and it has to be evaluated.

M.Tech. (VLSI & Embedded Systems Full Time)

Detailed Syllabus

(effective from Academic Year 2017)

Semester – I:

Course Code	Course Title	Duration		L	T	P	C
MT17VS101	Advanced Mathematics	14 Weeks	HC	4	1	0	5

Prerequisites:

1. Basic knowledge of matrix mathematics and linear transformations.
2. Linear and parabolic partial differentiation and scalar wave equation in one space dimension.
3. Basics of Laplace transforms, Fourier transforms and Poisson equation by Fourier transform.
4. Simplex algorithm and nonlinear programming.

Course Objectives:

1. To understand the advanced concepts in Matrix theory and calculus
2. To Study the numerical, analytical and logical problem solving using transform methods
3. To learn applications of Poisson and Fourier transform methods.
4. To understand the concept of elliptic equation.
5. To study the various algorithms in linear and nonlinear programming.

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and describe different techniques in solving Engineering problems using Matrix method
2. Describe the Euler equation of first and higher order degree.
3. Apply Laplace transform to one dimensional wave.
4. Analyse properties of harmonic functions.
5. Present the concepts Two Phase and Big M techniques.
6. Explain problem solving using Lagrange's multiplier method.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO 1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
MT17VS101	CO1	3	2	3	4					3			1	1	2
	CO2	3	3	2	1				2					2	1
	CO3	1	3	2	1					1					

	CO4	**2**	**3**	**1**	**2**										
	CO5	**3**	**3**	**2**	**1**				**2**					**2**	**1**
	CO6	**3**	**3**	**2**	**1**				**2**					**2**	**1**

Course Contents:

Unit 1: Matrix Theory, Calculus of Variations [14]

QR EL Decomposition – Eigen values using shifted QR algorithm- Singular Value EL Decomposition - Pseudo inverse- Least square approximations

Concept of Functional- Euler's equation – functional dependent on first and higher order derivatives – Functional on several dependent variables – Isoperimetric problems- Variation problems with moving boundaries.

Unit 2:Transform Methods [14]

Laplace transform methods for one dimensional wave equation – Displacements in a string – Longitudinal vibration of an elastic bar – Fourier Transform methods for one dimensional heat conduction problems in infinite and semi-infinite rod.

Unit 3:Elliptic Equation [14]

Laplace equation – Properties of harmonic functions – Fourier transforms methods for Laplace equations. Solution for Poisson equation by Fourier transforms method.

Unit 4:Linear and Non Linear Programming [14]

Simplex Algorithm- Two Phase and Big M techniques – Duality theory- Dual Simplex method. Non Linear Programming –Constrained external problems- Lagrange's multiplier method- Kuhn- Tucker conditions and solutions.Recent trends in the related areas from journals, Conference proceedings Book chapters.

References:

1. Richard Bronson, "**Schaum's Outlines of Theory and Problems of Matrix Operations**", McGraw-Hill, 1988.
2. Venkataraman M. K., "**Higher Engineering Mathematics**", National Publications Co., 1992.
3. Elsgolts, L., "**Differential Equations and Calculus of Variations**", Mir, 1977.
4. Sneddon, I.N., "**Elements of Partial Differential Equations**", Dover Publications, 2006.
5. Sankara Rao, K., "**Introduction to Partial Differential Equations**", Prentice – Hall of India,1995.
6. Taha H A, "**Operations Research - An Introduction**", McMilan Publishing co, 1982.

Course Code	Course Title	Duration		L	T	P	C
MT17VS102	CMOS VLSI Design	14 Weeks	HC	4	0	1	5

Prerequisites:

1. Working principle of MOS transistor theory and MOSFET characteristics.
2. Static characteristics, transient response and propagation delay calculations of MOS inverters.
3. Basic principles of pass transistor circuits and dynamic CMOS characteristics.
4. Basics of volatile memory and non-volatile memory and low power CMOS logic circuits.
5. Knowledge on BiCMOS and BJT theory.
6. Concept of electrostatic discharge (ESD) and basics of latch up prevention and process variations.

Course Objectives:

1. To understand an overview of working principle of MOS transistor and MOS inverters.
2. To be acquainted with all the definitions associated with MOS inverters.
3. To understand dynamic logic circuits.
4. To get understand of semiconductor memory.
5. To study chip input output devices.

Course Outcomes:

On completion of this course the student will be able to:

1. Explain the working principle of MOS transistor and MOS inverters
2. Define all the definitions associated with MOS inverters
3. Analyse dynamic logic circuits
4. Describe the semiconductor memory
5. Explain chip input output devices

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
MT17VS102	CO1	3	2		2		1	1			2		3		3	2
	CO2	3	3	3			1			2			2		3	2
	CO3	3	3				2			1			1		3	2
	CO4	3	3			2							1		3	2
	CO5	3	3			2							1		3	2

Course Contents:

Unit 1: MOS Transistor, MOS Inverters [14]

The Metal Oxide Semiconductor (MOS) Structure, the MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current-Voltage Characteristics, and MOSFET Scaling and Small-Geometry Effects.

Static Characteristics: Introduction, Resistive-Load Inverter, Inverters with type MOSFET Load, CMOS Inverter.

Unit 2: MOS Inverters (continued) [14]

Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definition, Calculation of Delay Times, and Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, and Switching Power Dissipation of CMOS Inverters.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

Unit3: Semiconductor Memories [14]

Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory, Ferroelectric Random Access Memory (FRAM). Low-Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low-Power Design Through Voltage Scaling, Estimation and Optimization of Switching Activity, Reduction of Switched Capacitance, Adiabatic Logic Circuits.

BiCMOS Logic Circuits: Introduction, Bipolar Junction Transistor (BJT): Structure and Operation, Dynamic Behavior of BJTs, Static Behavior, Switching Delay in BiCMOS Logic Circuits, BiCMOS Applications.

Unit 4:Chip Input and Output (I/O) Circuits
[14]

Introduction, ESD Protection, Input Circuits, Output Circuits and L (di/dt) Noise, On-Chip Clock Generation and Distribution, Latch-Up and Its Prevention.

Design for Manufacturability : Introduction, Process Variations, Basic Concepts and Definitions, Design of Experiments and Performance Modeling, Parametric Yield Estimation, Parametric Yield Maximization, Worst-Case Analysis, Performance Variability Minimization.

Recent trends in the related areas from journals, Conference proceedings Book chapters.

References:

1. Sung Mo KangandYosufLeblebici, “**CMOS Digital Integrated Circuits: Analysis and Design**”, Tata McGraw-Hill, Third Edition, 2003.
2. Neil Weste and K. Eshragian, “**Principles of CMOS VLSI Design: A System Perspective**”, Second Edition, Pearson Education (Asia) Pvt. Ltd. 2000.

CMOS VLSI Lab

Course Objectives:

1. To understand the ASIC Design flow
2. To demonstrate VLSI CAD tool- Cadance
3. To desing VLSI Digital Circuits
4. To perform Area, power and timing analysis of the designed digital circuits.

Course Outcomes:

On completion of this course the students will be able to:

1. Design the digital VLSI circuits (a, b , c , d)
2. Perform the Power, area and timing analysis of the designed digital circuits (a, b, c, d)

Lab Experiments

1. Write a VHDL/Verilog code to realize the A Buffer. Simulate & synthesize the same on FPGA kit.
2. Write a VHDL/Verilog code to realize the inverter. Simulate & synthesize the same on FPGA kit.
3. Write a VHDL/Verilog code to realize the Transmission Gate. Simulate & synthesize the same on FPGA kit.
4. Write a VHDL/Verilog code to realize the universal gates Simulate & synthesize the same on FPGA kit..
5. Write Verilog / VHDL Code for the following circuits and their Test Bench for **verification**, observe the waveform and **synthesis** the code with technological library with given Constraints.
   a. RS Flip flop
   b. D Flip flop
   c. JK Flip flop
   d. T Flip flop
   e. Master Slave JK Flip flop
6. Write Verilog / VHDL Code for the Serial & Parallel adderand their Test Bench for **verification**, observe the waveform and **synthesis** the code with technological library with given Constraints.
7. Write a VHDL/Verilog code to realize the kit 4-bit counter [Synchronous and synchronous counter] Simulate & synthesize the same on FPGA kit.
8. Write a VHDL/Verilog code to realize l the kit Successive approximations register [SAR]. Simulate & synthesize the same on FPGA.
9. Mini Project*

Course Code	Course Title	Duration		L	T	P	C
MT17VS103	Advanced Embedded Systems Design	14 Weeks	HC	4	0	1	5

Prerequisites:

1. Concept of Embedded systems and its design optimization.
2. Knowledge on architecture of embedded systems and embedded microcontroller cores.
3. Working principle of interfacing subsystems and external systems and DSP.
4. Concepts of real time programming and RTOS.

Course Objectives:

1. Understand how to design an embedded system.
2. To know how to partition a system to hardware and software parts efficiently.
3. To know Hardware/software Co-design concepts.
4. To Understand the Architecture and Working of ARM Cortex-M3 Processors and Controllers.
5. To study the concepts of Architectural Support for High level languages.
6. To study the concepts of Architectural support for system Development and Operating systems.

Course Outcomes:

On completion of this course the students will be able to:

1. Design embedded system architectures for various applications.
2. Implement, Identify, formulate, and solve engineering problems.
3. Analyze and Compare various Processor and Controller Architectures with ARM
4. To identify different functional blocks in an ARM Microcontroller and their Applications
5. Program ARM Cortex-M3 MCUs by identifying the software development tools

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MT17VS103	CO1	3	3	3		2				2	3		3	2	3	2
	CO2	3	3	3		2				2	3		3	2	3	2
	CO3	3	3	3		2				2	3		3	2	3	2
	CO4	3	3	3		2				2	3		3	2	3	2
	CO5	3	3	3		2				2	3		3	2	3	2

Ref: RU/ECE/BOS/CEC/June 2018-6

Course Contents:

Unit 1:Introduction **[14]**

Overview of embedded systems, embedded system design challenges, common design metrics and optimizing. Survey of different embedded system design technologies & trade-offs. Embedded microcontroller cores, embedded memories, Examples of embedded systems. Architecture for embedded system.

Unit 2: Introduction to Cortex-M3 Processor **[14]**

A Brief History, Architecture Versions, Different MCU architectures vs ARM, ARM Processor Families, Cortex-M3 Processor Applic Interrupt/Exception Sequences, Nested Interrupts, Tail-Chaining, Late Arrivals, Interrupt Latency, Exception/Interrupt Handlers, Software Interrupts

Unit 3:Cortex-M3Programming **[14]**

A Typical Development Flow, Development Tools – C Compilers and Debuggers, Embedded OS Support, Embedded C Programming using Keil MDK-ARM

Cortex Microcontroller Software Interface standard (CMSIS) – Areas of standardization, Organization and using CMSIS, Overview of NxP's LPC1768, Memory map, Understanding different functional blocks and their Applications in LPC 1768 - System Control, Clocking and Power Control, Timers, WDT, RTC, ADC, I2C, SPI

Unit 4:Cortex-M3MicrocontrollersProgramming and Development **[14]**

Pin Connect block, GPIO Programming, Configuring GPIOs for External Interrupts. Understanding UART and its Applications, Configuration for Serial Communication.

Reference Books:

1. Jack Ganssle, "**The Art of Designing Embedded Systems**", Elsevier, 1999.
2. J.W. Valvano, "**Embedded Microcomputer System: Real Time Interfacing**", Brooks/Cole, 2000.
3. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
4. Gomaa, "**Software Design Methods for Concurrent and Real-time Systems**", Addison-Wesley, 1993.
5. InstructorReferenceMaterial
6. JosephYiu, "THE DEFINITIE GUIDE TOTHE ARMCORTEX-M3"
7. ManualsandTechnicalDocumentsfromthe ARM Inc, web site.

Advanced Microcontroller Lab

Course Objectives:

1. To Learn C Programming, Debugging and Interfacing Peripherals for a given ARM Cortex-M3Microcontroller.

Course Outcomes:

The students will be able to

1. Program ARM Cortex-M3 MCU Target using Keil uVision IDE
2. Interface and Program hardware peripherals like LED, Push Button Switch, LCD, Keypad
3. Establish serial communication between the MCU target and Desktop PC.

Laboratory Experiments:

1. Interface an External Push Button Switch, LED, with MCU target board, and Write a C Program to Configure and Control the ON-OFF operation of the LED using the switch. (*Configure Switch as an External interrupt source*)
2. Interface a 4x4 Matrix Keypad, LEDs Array, with MCU target board, and Write a C program to display the binary equivalent pattern of the numeric key pressed on the LEDs array.
3. Interface a 16x2 LCD for its 4-bit mode operation, with MCU target board and Write a C Program to display a message on both the lines of the LCD.
4. Write a C Program to Configure the on-chip UART functional block of the MCU target board to output a message on serial terminal of a host machine via its serial/ COM port.

Course Code	Course Title	Duration		L	T	P	C
MT17VS114	Advanced Digital System Design using Verilog	14 Weeks	SC	4	1	0	5

Prerequisites:

Knowledge on Digital system design, Boolean algebraic theorems and number systems, Basics of sequential logic and memory types, Principles of ICs, PLDs and interfacing memory.

Course Objectives:

This course will enable students to:

1. Understand the concepts of Verilog Language.

2. Design the digital systems as an activity in a larger systems design context.
3. Study the design and operation of semiconductor memories frequently used in application specific digital system.
4. Illustrate the different components and functions related to design of Combinational circuits.
5. Illustrate the different components and methodology related to design of Sequential circuits.
6. Provide an Understanding to concepts FSM basics.

Course Outcomes:

After studying this course, students will be able to:

1. Design & Construct the combinational circuits using discrete gates and programmable logic devices.
2. Describe Verilog model for sequential circuits and test pattern generation.
3. Apply different modeling techniques in the programming of Verilog HDL
4. Explore the different types of semiconductor memories and their usage for specific chip design.
5. Understand and analyze the programming of combinational and sequential logic design in Verilog HDL
6. Design and synthesis of different types of processor and I/O controllers that are used in embedded system design.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MT17VS114	**CO1**	**4**	**4**	**3**	**3**	**2**							**1**	**1**		**2**
	CO2	**1**	**4**	**3**	**3**	**2**							**2**	**1**		**2**
	CO3	**4**	**3**	**4**	**2**	**2**					**1**		**1**	**1**		**2**
	CO4	**1**	**3**	**4**		**2**							**1**	**1**		**2**
	CO5	**4**	**4**	**3**	**3**	**2**							**1**	**1**		**2**
	CO6	**1**	**4**	**3**	**3**	**2**							**2**	**1**		**2**

Unit 1: Introduction to Digital System and Methodology [14]

Digital Systems and Embedded Systems, Binary representation and Circuit Elements, Real-World Circuits, Design Methodology.

Gate-level combinational circuit: Introduction, General description, Basic lexical elements and data types, Data types, Program skeleton, Structural description, Test bench.

Overview of FPGA and EDA software: Introduction, Architecture of FPGA, Development flow, HDL for combinational Circuits, Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter.

Unit 2: Functions tasks and User defined Primitives [14]

Introduction, functions, tradeoff between hardware and speed, scope of functions, recursive functions, tasks, task definition, task enabling, user defined primitives, combinational UDPs, More general combinational UDPs, Instantiation of UDP, Combinational UDP and Function, Sequential UDPs, UDP instantiation with delays, vector type instantiation of UDP

Unit 3: Sequential Basics: [14]

Storage Elements, Flip-flops and Registers, Shift Registers, Latches, Sequential Data paths and Control, Finite-State Machines, Clocked Synchronous Timing Methodology, Asynchronous Inputs, Verification of Sequential Circuits, Asynchronous Timing Methodologies,

Memories: General Concepts Memory Types, Asynchronous Static RAM Synchronous Static RAM, Multiport Memories, Dynamic RAM, Read - Only Memories.

Unit 4: Queues, PLAS, Compiler directives and FSMS: [14]

File based tasks and functions, compiler directives, time related tasks, queues, PLDs, programming PLD in Verilog, Design of finite state machine- Moore machine, Melay machine.

Text Books

1. T.R. Padmanabhan, B. Bala Tripura Sundari , Design through Verilog HDL", Wiley Publication.
2. Pong P Chu, "FPGA Prototyping by Verilog Examples", Wiley, 2006.

References:

1. Peter J. Ashenden, **"**Digital Design: An Embedded Ssytems Approach Using VERILOG", Elesvier, 2010.
2. Frank Vahid, "Digital Design", Wiley, 2006.

Course Code	Course Title	Duration		L	T	P	C
MT17VS124	Semiconductor Device Modeling & Technology	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Basic knowledge of Electronics Devices.

Course Objectives:

1. Understand the basic concepts of semiconductor materials
2. Characterize the concepts of P- N Junction diode
3. Understand the basic characteristics of metal semiconductor junction
4. Study the device modeling

Course Outcomes:

On completion of this course the student will be able to:

1. Analyze the concepts of semiconductor materials and analyze its properties
2. Analyze the characteristics and concepts of P-N Junction Diode
3. Analyze the characteristics and concepts of Metal-Semiconductor Junction

4. Analyze the characteristics and concepts of MOSFET and BJT
5. Apply, Awareness and Understanding of current trends in semiconductor device modeling in Design and Fabrication Unit

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MT17VS124	CO1	3		2	1									3	1	2
	CO2	2		3	1									2	1	3
	CO3	1		3	2									1	2	3
	CO4	3		1	2									1	3	2
	CO5	3		2	1									3	1	2

Course Contents:

Unit 1:Semiconductor Materials [14]

Intrinsic carrier concentration: Dopant atoms and energy levels, Ionization energy: the extrinsic semiconductor, Position of Fermi-energy level, variation of EF with doping concentration and temperature. Carrier drift: mobility, conductivity and velocity saturation, Carrier Diffusion: diffusion current density, total current density, The Einstein relation, Excess carrier generation and recombination, Characteristics of excess carriers – continuity equation and time-dependent diffusion equation.

Unit 2: PN Junction diode [14]

Basic structure, built-in potential, electric field, space charge width, reverse applied bias space charge width and Electric field, junction capacitance, Ideal current-voltage relationship, minority carrier distribution, Ideal PN-junction currents under forward and reverse bias, Temperature effects, small signal model of PN-junction, Equivalent circuits, recombination current, junction breakdown; SPICE models of p-n diode.

Unit 3: Metal Semiconductor Junction and FET Capacitor [14]

Schottky barrier, I-V and C-V characteristics of M-S junction, thermal emission and tunneling current, Field-Effect Transistors: JFET- current-voltage characteristics, effects in real devices, high-frequency and high-speed issues. MOS structure: Energy band diagrams, work function difference, Depletion layer thickness, Flat band voltage, threshold voltage, charge distribution, MOS Capacitance – voltage characteristics.

Unit 4: Bipolar Transistor and Current trends [14]

Basic Principle of Operation: Simplified transistor current relationship, Modes of operation, amplification with bipolar transistors, Minority carrier distribution, Forward active mode and other modes of operation, Low frequency common base current gain, Non-ideal effects – Base width modulation, breakdown voltage, equivalent circuit models, Eber's – Moll model, Hybrid – pi model, Frequency limitation, large signal switching; SPICE models of BJT.

References:

1.N. Das Gupta, and A. DasGupta, Semiconductor Devices: Modelling and Technology, Prentice Hall of India Private Limited, New Delhi, 2004.
2. B. G. Streetman and S. Banerjee, Solid State Electronic Devices, 5th edition, Prentice Hall of India Private Limited, New Delhi, 2000.
1. Chenming Calvin Hu, Modern Semiconductor Devices for Integrated Circuits, Pearson, 2009.
2. Y. Taur, and T. H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University press, 1998
3. S. M. Sze, **"VLSI Technology**", 2nd edition, McGraw-Hill, 1998
4. S. K. Dieter, **"Semiconductor Material and Device Characterization,"** by John Wiley and Sons, New York, 1990.
5. G. W. Roberts and A. S. Sedra SPICE 2nd edition, Oxford University Press, 1997
6. Yuan TaurandTak H. Ning, **"Fundamentals of Modern VLSI Devices",** Cambridge University Press; 2 edition, 2013.

Course Code	Course Title	Duration		L	T	P	C
MT17VS134	Internet of Things- Practical Approach	14 Weeks	SC	4	1	0	5

Prerequisites:

Basics of wireless networks, protocols, sensors

Course Objectives:

1. To introduce the full connected-product experiences by integrating Internet services and physical objects
2. To give an insight into developing prototypes of Internet-connected products using appropriate tools
3. To introduce theBasic Arduino programming. Extended Arduino libraries. Arduino-based Internet communication
4. To provide insght intoXML and JSON, HTTP APIs for accessing popular Internet services

Course Outcomes

On completion of this course the student will be able to:

1. Understand full connected-product experiences by integrating Internet services and physical objects
2. Analyzing, designing, and developing prototypes of Internet-connected products using appropriate tools .

3. Identifying, classifying and describing different kinds of Internet-connected product concepts Describe different network protocols
4. Analyzing the challenges and applying adequate patterns for user-interaction with connected-objects

Mapping of Course Outcomes with programme Outcomes

Cours e Code	POS / COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
	CO1	**1**				**2**	**3**							**3**	**1**	**2**
	CO2	**2**	**1**			**2**	**3**							**2**	**1**	**3**
	CO3	**1**				**2**	**3**							**3**	**2**	**1**
	CO4	**1**				**2**	**3**									

Course Contents:

Unit 1:Introduction to the Internet of Things **[14]**

Origins. Early concepts and products. Examples of current products and value propositions. Architectures and design patterns. Analysis of a full connected-object experience. State of the Art, challenges and future directions.

Unit 2: Prototyping Connected Objects **[14]**

Open-source prototyping platforms. Basic Arduino programming. Extended Arduino libraries. Arduino-based Internet communication. Practical activities

Unit 3: Integrating Internet Services **[14]**

XML and JSON. HTTP APIs for accessing popular Internet services (Facebook, Twitter, and others). Practical activities

Unit 4: Project Development and Competition **[14]**

Development of a project including: value proposition, physical connected object prototyping, programming the behaviour, accessing Internet services and designing the user experience. Case studies

Reference books:

1. Smart Things: Ubiquitous Computing User Experience Design. Mike Kuniavsky. Morgan Kaufmann Publishers. 2010
2. Meta Products: Building the Internet of Things. Sara Cordoba, WimerHazenberg, Menno Huisman. BIS Publishers. 2011.
3. Getting Started with Arduino (Make: Projects). Massimo Banzi. O'Reilly Media. 2008
4. Emotional Design: Why We Love (or Hate) Everyday Things. Donald A. Norman. Basic Books, 2004.
5. Physical Computing: Sensing and Controlling the Physical World with Computers. Tom Igoe, Dan O'Sullivan. Premier Press. 2004.

Course Code	Course Title	Duration		L	T	P	C
MT17VS115	Unix/Linux Shell Scripting and Python Basics	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Basic knowledge of Unix OS.

Course Objectives:

1. Understand the and write the shell scripts
2. Understand the concept of process in Unix
3. Study the basic concepts of python scripting language

Course Outcomes:

On completion of this course the student will be able to:

1. Design scripting code for a given application
2. Apply various conditional statements, loops and command line arguments to develop the script code
3. Develop the python scripting code

Mapping of Course Outcomes with programme Outcomes

Cour se Code	POS / COs	P O 1	P0 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PS O 1	PS O 2	PS O 3
MT17VS115	**CO1**		**2**	**1**		**3**								**3**	**1**	**2**
	CO2	**2**	**1**		**2**	**3**								**2**	**1**	**3**
	CO3	**1**		**2**		**3**								**3**	**2**	**1**

Course Contents:

Unit 1: Shell Basics, Writing first script **[14]**

Types of shells, Shell functionality, Environment, Writing script & executing basic script, Debugging script, Making interactive scripts, Variables (default variables), Mathematical expressions,

Conditional Statements and Loops: If-else-elif, Test command, Logical operators-AND,OR,NOT, ase –esac, Loops, While, For, Until, Break & continue.

Unit 2:Command line arguments **[14]**

Positional parameters, Set & shift, IFS, Break & continue, Processing file line by line Functions, What is regular expression, Grep, cut, sort commands, Grep patterns.

Unit 3: SED& AWK, Processes **[14]**

Concept of process in Unix, Background processes, Scheduling processes -At, batch &Cron

Unit 4: Python Basic **[14]**

Latest developments in the semiconductor device modeling and introduction to device simulation tools & technologies, e.g., Silvaco-CMOS Process and Smart SPICE. Exposure to equipment and process used in Semiconductor Fab. Unit, Test and Measure Equipments.

References:

1. Brian W. Kernighan & Rob Pike, The Unix Programming Environment, Prentice Hall of India Private Limited, New Delhi, 2004.
2. Carl Albing, JP Vossen, and Cameron Newham,BashCookbook,O'Reilly 2007.
3. Tim Hall and J-P Stacey,Python 3 for Absolute Beginners, Apress, 2009.

Course Code	Course Title	Duration		L	T	P	C
MT17VS125	SOC Design	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Basics of SoC design and system architecture.
2. Concepts of interconnect architecture and bus architecture of Soc.
3. Principles of memory design and cache architecture.
4. Basic knowledge of ASIC design flow and FPGA design flow.

Course Objectives:

1. Provide a comprehensive introduction to the ASIC and SoC technology.
2. Provide theoretical and practical aspects of ASIC and SoC design.
3. Introduce ASIC design, ASIC library design and Programmable ASIC.
4. Give an overview to SoC design, its challenges and Design flow.
5. To understand the memory design concepts in processors.
6. To understand ASIC design flow using semi/full /standard cells.

Course Outcomes:

On completion of this course the students will be able to:

1. Select the appropriate processors for a given application keeping area, power and speed as constraints and to Deepen CMOS VLSI design knowledge
2. Design full custom/ semicustom/ standard cells for ASIC
3. Implement network on chip technologies
4. Analyze memories using reconfigurable architectures for rapid prototyping
5. Analyze system on chip and board based systems.

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
	CO1		**2**	**1**		**3**								**3**	**1**	**2**
	CO2	**2**	**1**		**2**	**3**								**1**	**3**	**2**
	CO3	**1**		**2**		**3**								**2**	**3**	**1**
	CO4		**2**	**1**		**3**								**3**	**1**	**2**
	CO5	**2**	**1**		**2**	**3**								**1**	**3**	**2**

Course Contents:

Unit-1: System Approach and Chip Basics **[14]**

System Architecture, Components of the System, Hardware and Software. An approach for SoC Design, System On Chip Design Process: A canonical SoC Design, SoC Design flow - waterfall vs spiral, Top-down vs Bottom up, System Architecture and Complexity. Chip Basics. Cycle Time, Die Area and Cost, Ideal and Practical Scaling, Power, Area–Time–Power Trade-Offs in Processor Design, Reliability, Configurability.

Unit-2: Processors and Interconnects **[14]**

Processor Selection for SoC, Basic Concepts in Processor Architecture, Instruction Handling, and Buffers, Minimizing Pipeline Delays, Branches. Vector, Very Long Instruction Word (VLIW), and Superscalar with case studies. Interconnect architectures for SoC. Bus architecture. Network on Chip topologies. Routing, Switching and Flow Control in NoCs.

Unit-3: Memory Design **[14]**

System-on-Chip and Board-Based Systems – Scratchpads and Cache Memory, Basic Notions, Cache Organization, Cache Data, Write Policies, Strategies for Line Replacement at Miss Time, Other Types of Cache, Split I- and D-Caches and the Effect of Code Density, Multilevel Caches, Virtual-to-Real Translation, SoC (On-Die) Memory Systems, Board-based (Off-Die) Memory Systems, Simple DRAM and the Memory Array, Models of Simple Processor–Memory Interaction.

Unit-4: ASIC Design **[14]**

Full/Semi Custom with ASIC, Standard Cell based ASIC, Gate array based ASIC, Programmable logic device, FPGA design flow, ASIC cell libraries. ASIC Library Design, Logical effort and library cell design. Low-Level Design Entry, Schematic Entry, Hierarchical design, the cell library, connections, vectored instances and buses, Edit in place attributes, Net list, screener, back annotation.

Text Books:

1. Micheal J Flynn and Wayne Luk,"**Computer System Design: System-on-Chip**," Wiley, First Edition, 2011.
2. Sudeep Pasricha and NikilDutt,"**On-Chip Communication Architectures: System on Chip**

Interconnect", Morgan Kaufmann, 2008.
3. Michael Keating, Pierre Bricaud, "**Reuse Methodology manual for System on chip designs**", Kluwer academic Publishers, 2nd edition-2008.
4. M.J.S .Smith, "**Application Specific Integrated Circuits**", Pearson Education, 2003.

References:

1. Rao R. Tummala, MadhavanSwaminathan, "**Introduction to system on package sop-Miniaturization of the Entire System**", McGraw-Hill-2008.
2. James K. Peckol, "**Embedded Systems: A Contemporary Design Tool**", WILEY Student Edition, 2007.
3. Ahmed Amine Jeraya, Wayne Wolf, "**Multiprocessor System On chip**", Morgan Kauffmann, 2005.

Semester – II:

Course Code	Course Title	Duration		L	T	P	C
MT17VS201	Design of Analog CMOS Integrated Circuits	14 Weeks	HC	4	0	1	5

Prerequisites:

1. Basics of MOS devices and its characteristics.
2. Concepts of single stage amplifiers and frequency response of amplifiers.
3. Knowledge on differential amplifiers, Operational amplifiers and current mirrors.
4. Basic knowledge on DAC and ADC architectures and phase locked loops.

Course Objectives:

1. To understand the basics and operation of MOS devices.
2. To analyse and understand analog CMOS integrated circuits.
3. To analyse and design single stage MOS amplifier circuits.
4. To understand the basic operation of differential amplifier and op-amps.

Course Outcomes:

On completion of this course the student will be able to:

1. Design single stage, differential and current mirror
2. Analyse the stability, feedback in amplifiers, op-amps
3. Design oscillators and PLL.
4. Design ADCs and DACs

Mapping of Course Outcomes with Program Outcomes

Course Code	POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
MT17VS201	CO1	3	2	3	1								2	1	3
	CO2	3	3	2	1								1	2	3
	CO3	2	2	3	2								3	1	
	CO4	2	1	2	1								2	3	

Course Contents:

Unit 1: Basic MOS Device Physics [14]

General considerations, MOS I/V Characteristics, second order effects, MOS device models. Single stage Amplifier: CS stage with resistance load, divide connected load, current source load, triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage, choice of device models**.**

Unit 2: Differential Amplifiers & Current Mirrors [14]

Basic difference pair, common mode response, Differential pair with MOS loads, Gilbert cell. Basic current mirrors, Cascade mirrors, active current mirrors.

Operational Amplifiers: One Stage OP-Amp, Two Stage OP-Amp, Gain boosting, Common Mode Feedback, Slew rate, Power Supply Rejection, Noise in Op Amps.

Unit 3: Oscillators and Phase Locked Loops **[14]**

Ring Oscillators, LC Oscillators, VCO, Mathematical Model of VCO. Simple PLL, Charge pump PLL, Non-ideal effects in PLL, Delay locked loops and applications. Band gap References and Switched capacitor Circuits: General Considerations, Supply Independent biasing, PTAT Current Generation, Constant Gm Biasing, Sampling Switches, and Switched Capacitor Amplifiers.

Unit 4: Data Converter Architectures **[14]**

DAC & ADC Specifications, Resistor String DAC, R-2R Ladder Network, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

References:

1. BehzadRazavi, **"Design of Analog CMOS Integrated Circuits**", TMH, 2007.
2. Philip Allen and Douglas Holberg, **"CMOS Analog Circuit Design",** Oxford University, Press, 2011.
3. R. Jacaob Baker, Harry W Li and David E Boyce, **"CMOS Circuit Design, Layout, Stimulation",**CMOS Circuit PHI Edn, 2005.

Design of Analog CMOS Integrated Circuits Lab

Course Objectives:

1. Learn the CAD tool and the flow of the Full Custom IC design cycle.
2. Design the various analog CMOS VLSI circuits.
3. Perform DRC, LVS and Parasitic Extraction of the various designs.

Course Outcomes:

1. Demonstrate the VLSI Cad tool to design CMOS VLSI analog circuits
2. Design, implement and analyse various Analog mixed mode circuits
3. Perform DRC, LVS for the designed circuits.
4. Carry out the mini project on the design of a CMOS subsystem.

Lab Experiments

1. Design of inverter with given specifications, and perform the following
    1. Draw the schematic and perform
        a. DC analysis
        b. Transient Analysis
    2 Draw the Layout and perform DRC and ERC
    3. Extract RC and Back annotate the same and verify the design
2. Design the following circuits with given specifications*, completing the design flow mentioned below:

    a.Draw the schematic and verify the following

    i) DC Analysis

    ii) AC Analysis

    iii) Transient Analysis

    b.Draw the Layout and verify the DRC, ERC, LVS

    d.Extract RC and back annotate the same and verify the Design.

    i) A Single Stage differential amplifier

    ii) Common source amplifier

    iii) Design an opamp with given specification.

Course Code	Course Title	Duration		L	T	P	C
MT17VS202	Real Time Operating Systems	14 Weeks	HC	4	0	1	5

Prerequisites:

1. Concepts of Operating systems.
2. Basics of task management and task scheduling.
3. Knowledge on RTOS and memory management.
4. Basic knowledge on performance metrics and RTOS tools.

Course Objectives:

1. To acquire knowledge about concepts related to OS such as Scheduling techniques,threads, inter-thread communications, memory management.
2. To acquire knowledge about different types of scheduling algorithms
3. To study about Free RTOS
4. To understand the various functions of RTOS

Course Outcomes:

On completion of this course the students will be able to:

1. Describe the fundamental concepts of RTOS

2. Develop programs for real time services, firmware and RTOS.
3. Develop programs formulate threaded applications on FreeRTOS

Mapping of Course Outcomes with Program Outcomes

Course Code	POs/ COs	PO1	PO 2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MT17VS202	**CO1**	**3**	**2**	**3**	**1**								**2**	**1**	**3**
	CO2	**3**	**3**	**2**	**1**								**1**	**2**	**3**
	CO3	**2**	**2**	**3**	**2**								**3**	**1**	

Course Contents:

Unit 1: Real time systems and Resources **[14]**

Real-Time Systems and Resources: Brief history of Real Time Systems, A brief history of Embedded Systems Requirements of Embedded System,Challenges in Embedded System. System Resources, Resource Analysis, Real-Time Service Utility.

Processing with Real Time Scheduling: Scheduler Classes, Preemptive Fixed Priority Scheduling Policies with timing diagrams, Rate Monotonic least upperbound,Necessary and Sufficient feasibility, Deadline –Monotonic Policy, Dynamic priority policies,Worst case execution time, Dead lock and live lock.

Unit 2: Real Time Operating Systems **[14]**

Operating System basics,The Kernel and its subsystems, Kernel Space and User Space, Kernel Architecture, Types of operating system, Task, process and Threads, Multi-Processing and Multitasking, Types of multitasking, Task Scheduling, Task states, Non-Preemptive scheduling, Preemptive Scheduling,Round Robin Scheduling,IdleTask,Task Communication, Task Synchronization,Thread Safe Reentrant Functions.

Unit 3: Embedded Firmware Design, development and Free RTOS **[14]**

Embedded Firmware Design Approaches, Super-loop based approach, Embedded Operating System based approach, Programming in Embedded C, Integrated development environment (IDE), Overview of IDEs for Embedded System Development.

Introduction to Free RTOS, multitasking on an LPC17xx Cortex-M3 Microcontroller, LPC17xx Port of Free RTOS, Resources Used by Free RTOS, Task Management, Task Functions, Task Priorities, Idle task and task hook function, Creation and Deletion of tasks.

Unit 4: Embedded System design with Free RTOS **[14]**

Queue Management, Characteristics of Queue, Working with Large Data, Interrupt Management, Queues within an Interrupt Service Routine, Critical Sections and Suspending the Scheduler, Resource Management, Memory Management.

References:

1. ARM Instructor Reference Material
2. SamSiewert**,"Real-Time Embedded SystemsAnd Components".**
3. Shibu K.V.**,"Introduction to Embedded System".**
4. "Using the Free RTOS Real-time Kernel" From Free RTOS.
5. Manuals and Technical Documents from the ARMInc, web site.

Real Time Operating System Lab

Course Objectives:

1. To Perform Multithreaded Programming in RTOS Platform.
2. To Acquire the Knowledge on working of Interrupts and Writing ISRs.

Course Outcomes:

The students will be able to

1. Program in C on FreeRTOS win32 and ARM Cortex-M3 Port.
2. Demonstrate Task Management.
3. Demonstrate Inter-Task Communication.

Laboratory Experiments:

1. Write a C Program to perform the task Management in FreeRTOS, using win32 port on Visual
   Studio IDE:
   a. Create Two Tasks and Pass the "*Task-Name*" as an argument to thetask function. b. Demonstrate the use of idle task hook function.
   c. Update the task priority dynamically.

2. Write a C Program to create a task in FreeRTOS, using win32 port on Visual Studio IDE; that periodically generates a software interrupt for every 1sec.

3. Write a C Program to Demonstrate Inter-Task Communication using Queues inFreeRTOS, use
   ARM Cortex-M3 Port (LPC1768 MCU Kit)
   a. Task-1 creates data (stores in a structure) and sends it to the queue
   b. Task-2 reads the message packet from the queue and reacts accordingly.

4. Write a C Program to Demonstrate Task Synchronization and Resource Sharing among multiple tasks in FreeRTOS, use ARM Cortex-M3 Port (LPC1768 MCU Kit)
   a. Assume multiple tasks trying to write data to a serial port.
   b. Use Mutex semaphore to gain exclusive access to serial port.

Course Code	Course Title	Duration		L	T	P	C
MT17VS213	Low Power VLSI Design	14 Weeks	SC	4	1	0	5

Prerequisites:
Concepts of low power VLSI design and scaling technologies involved, Knowledge on simulation programming with integrated circuits and probabilistic power analysis, Basics of design parameters of low power circuits and low power architecture, Knowledge on clock distribution and architectural level methodologies.

Course Objectives:
This course will enable students to:
1. understand different sources of power dissipation in CMOS & MIS structure.
2. explore the different types of low power adders and multipliers.
3. focus on synthesis of different level low power transforms.
4. Analyze the various energy recovery techniques used in low power design.

Course Outcomes:
Course Outcomes:
On completion of this course the student will be able to:
1. Analyse different source of power dissipation and the factors involved.
2. Understand the different techniques involved in low power adders and multipliers.
3. Understandings of the impact of various low powers transform
4. Identify and analyse the different techniques involved in low power design

Mapping of Course Outcomes with Program Outcomes:

Course Code	POs/ COs	P O	PO 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O	P O	P O	PS O1	PS O2	PS O3
MT17 VS213		1									10	11	12			
	CO1	3	3							3	3	2				
	CO2	3	2	3						3	3	3		3		3
	CO3	3	3							3	2	3				
	CO4	3	3							2	1	3		3		

Course Contents:

Unit 1: Introduction **[14]**

Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Impact of technology Scaling, Technology.

Unit 2: Power estimation, Simulation Power analysis **[14]**

SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Unit 3: Synthesis for low power and Low power Clock distribution **[14]**

Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation,

Clock distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network.

Unit 4: Algorithm and Architectural Level Power Analysis and Optimization **[14]**

Algorithm & Architectural Level Methodologies: Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

Software design for Low power: Introduction, sources of software power dissipation, software power estimation, software power optimization- minimizing the memory access costs.

Text Books:

1. Kaushik Roy, Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**" Wiley, 2000.
2. Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002.
3. Rabaey, Pedram, "**Low Power Design Methodologies**" Kluwer Academic, 1997.

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Course Code	Course Title	Duration		L	T	P	C
MT17VS223	VLSI for Signal Processing	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Concepts of DSP systems and its architecture.
2. Basic knowledge on FIR digital filters.
3. Concepts of retiming and systolic architecture.
4. Knowledge of recursive and adaptive filters.
5. Basics on algorithms used in fast convolution method.

Course Objectives:

1. To understand the basic concepts of DSP algorithms.
2. To analyze the various pipelining and parallel processing techniques.
3. To analyze the retiming and unfolding algorithms for various DSP applications.

Course Outcomes:

On completion of this course the student will be able to:

1. Apply DSP algorithms on to the IC technology
2. Analyze the concept of pipelining and other processing for DSP applications

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO 1	P02	PO 3	PO4	PO5	PO6	P7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	1		2			3							3	1	2
	CO2	1	3				3							2	1	3
	CO3	1		2			3							3	2	1

Course Contents:

Unit 1: Introduction to DSP systems **[14]**

Typical DSP Algorithms, DSP Application Demands and Scaled CMOS Technologies, Representations of DSP Algorithms.

Iteration Bounds:Data flow graph Representations, loop bound and Iteration bound, Algorithms for Computing Iteration Bound, Iteration Bound of multi rate data flow graphs.

Pipelining and parallel processing, pipelining of FIR Digital Filters, parallel processing, Pipelining and parallel processing for low power.

Unit 2: Retiming **[14]**

Definition and Properties, Solving Systems of Inequalities, Retiming Techniques, Unfolding an Algorithm for Unfolding, Properties of Unfolding, and Critical path, Unfolding and Retiming, Application of Unfolding.

Systolic architecture design: systolic array design Methodology, FIR systolic array, Selection of Scheduling Vector, Matrix-Matrix Multiplication and 2D systolic Array Design, Systolic Design for space representation containing Delays**.**

Unit 3: Fast convolution **[14]**

Cook-Toom Algorithm, Winograd Algorithm, Iterated convolution, cyclic Convolution Design of fast convolution Algorithmby Inspection.

Unit 4: Pipelined and Parallel recursive and adaptive filter **[14]**

Pipeline Interleaving in Digital Filter, first order IIR digital Filter, Higher order IIR digital Filter, parallel processing for IIR filter, Combined pipelining and parallel processing for IIR Filter, Low power IIR Filter Design Using

Pipe lining and parallel processing, pipelined Adaptive digital filter.

References:

1. KeshabK.Parthi, "**VLSI Digital Signal Processing systems, Design and Implementation**", Wiley, Inter Science, 1999.
2. Mohammed Isamail and Terri Fiez, "**Analog VLSI Signal and Information Processing**", Mc Graw-Hill, 1994.
3. S.Y. Kung, H.J. White House, T. Kailath, "**VLSI and Modern Signal Processing**", Prentice Hall, 1985.
4. Jose E. France, YannisTsividis, "**Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing**", Prentice Hall, 1994.

Course Code	Course Title	Duration		L	T	P	C
MT17VS214	High Speed VLSI Design	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Knowledge on high speed digital design and its issues.
2. Concept of noise and power supply network.
3. Principles of synchronization and timing convention.
4. Basic knowledge on clocked and no clocked logics and latching strategies.

Course Objectives:

1. Introduce the concept of high speed digital circuits.
2. Understand the power distribution and noise sources in VLSI circuits.
3. Understand the importance of timing analysis in high speed VLSI circuits.
4. Introduce the concept of latch and clock driven logic circuits for high speed VLSI circuits.

Course Outcomes:

On completion of this course the student will be able to:

1. Identify and analyse the sources of noise in VLSI circuits.
2. Describe the Signalling modes for transmission lines in VLSI circuits
3. Perform the timing analysis for VLSI Circuits
4. Design the clocked and non-clocked logic circuit
5. Design various latch based digital circuits.

Mapping of Course Outcomes with Program Outcomes:

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MT17 VS214	**CO1**	**3**	**3**							**3**	**3**	**2**				
	CO2	**3**	**2**	**3**						**3**	**3**	**3**		**3**		**3**
	CO3	**3**	**3**							**3**	**2**	**3**				
	CO4	**3**	**3**							**2**	**1**	**3**		**3**		
	CO5	**3**	**3**							**2**	**1**	**3**		**3**		

Course Contents:

Unit 1: Introductionto High Speed Digital Design [14]

Frequency, time and distance issues in digital VLSI design. Capacitance and inductance effects, high speed properties of logic gates, speed and power.Modeling of wires, geometry and electrical properties of wires, Electrical models of wires, transmission lines, lossless LC transmission lines, lossy RLC transmission lines and special transmission lines.

Unit 2:Power distribution and Noise [14]

Power supply network, local power regulation, IR drops, area bonding. On-chip bypass capacitors and symbiotic bypass capacitors. Power supply isolation. Noise sources in digital systems, power supply noise, crosstalk and inter symbol interference.

Signaling convention and circuits: Signaling modes for transmission lines, signaling over lumped transmission media, signaling over RC interconnect, driving lossy LC lines, simultaneous bi-directional signaling terminations, transmitter and receiver circuits.

Unit 3: Timing Convention and Synchronization [14]

Timing fundamentals, timing properties of clocked storage elements, signals and events, open loop timing, level sensitive clocking, pipeline timing, closed loop timing, clock distribution, synchronization failure and meta-stability, clock distribution, clock skew and methods to reduce clock skew, controlling crosstalk in clock lines, delay adjustments, clock oscillators and clock jitter - PLL and DLL based clock aligners.

Unit 4: Clocked& Non-Clocked Logics **[14]**

Single-Rail Domino Logic, Dual-Rail Domino Structures, Latched Domino Structures, Clocked Pass GateLogic, Static CMOS, DCVS Logic, Non-Clocked Pass Gate Families.

Latching Strategies:Basic Latch Design, and Latching single-ended logic and Differential Logic, Race Free Latches for Pre-charged Logic Asynchronous Latch Techniques.

References:

1. William S. Dally & John W. Poulton, "**Digital Systems Engineering**", *Cambridge University Press*, 1998.
2. Kerry Bernstein &ET. Al., "**High Speed CMOS Design Styles**", Kluwer, 1999.
3. Howard Johnson & Martin Graham, "**High Speed Digital Design**" A Handbook of Black Magic, *Prentice Hall PTR*, 1993.
4. Masakazu Shoji, "**High Speed Digital Circuits**", *Addison Wesley Publishing Company*, 1996.
5. Jan M, Rabaey, et al, "**Digital Integrated Circuits**", A Design Perspective, *Pearson*, 2003.

Course Code	Course Title	Duration		L	T	P	C
MT17VS224	ASIC Design and Verification using System Verilog	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Fundaments knowledge of Digital System Design with Verilog HDL
2. Data Structures & Algorithm in C++

Course Objectives:

1. To study the basic concepts of system verilog.
2. Study the different kinds of data types
3. Differentiate between HDL and HVL
4. Study the basic concepts of OOPs

Course Outcomes:

On completion of this course the student will be able to:

1. Model a scenario for Verification of a DUT in System Verilog
2. Analyze the usefulness of a driver, monitor, checker, test cases in a verification environment

3. Understand different kinds of datatypes and can distinguish difference between an HDL and HVL
4. Design test bench to verify the functionality of a design
5. Understand the concept of randomization and its importance in verification coverage in a bigger design
6. Able to design a VIP for an IP as a project

Mapping of Course Outcomes with Program Outcomes:

Course Code	POS/ COs	PO1	P02	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3
MT17VS224	**CO1**	**3**	**2**	**2**	**3**	**3**	**3**		**3**	**2**	**2**	**1**	**3**	**3**	**3**
	CO2	**3**	**2**	**2**	**3**	**3**	**3**		**3**	**2**	**2**	**1**	**3**	**3**	**3**
	CO3	**3**	**3**	**2**	**3**	**3**	**3**		**3**	**2**	**2**	**1**	**3**	**3**	**3**
	CO4	**3**	**2**	**2**	**2**	**2**	**3**		**3**	**2**	**2**	**1**	**2**	**2**	**2**
	CO5	**3**	**2**	**2**	**3**	**3**	**3**		**3**	**2**	**2**	**1**	**3**	**3**	**3**
	CO6	**3**	**2**	**2**	**3**	**3**	**3**		**3**	**2**	**2**	**1**	**3**	**3**	**3**

Course Contents:

Unit 1: Verification Guidelines and Data Types [14]

Introduction, The Verification Process, The Verification Plan, The Verification Methodology, Manual, Basic Testbench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Building a Layered Testbench, Simulation Environment Phases, Maximum Code Reuse, Testbench Performance. Introduction to data types, Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width, Net Types.

Unit 2: Procedural Statements and Routines [14]

Introduction, Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

Unit 3: Basic OOPs [14]

Introduction, Think of Nouns, not Verbs, Your First Class, Where to Define a Class, OOP Terminology, Creating New Objects, Object Deallocation, Using Objects, Static Variables vs. Global Variables, Class Routines, Defining Routines Outside of the Class, Scoping Rules, Using One Class Inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Private Straying Off Course, Building a Testbench.

Unit 4:Connecting the Testbench and Design [14]

Introduction, Separating the Testbench and Design, The Interface Construct, Stimulus Timing,

Interface Driving and Sampling, Connecting It All Together, Top-Level Scope, Program – Module Interactions, SystemVerilog Assertions, The Four-Port ATM Router.
Current Trends in Testing and Verification: Advanced verification methodologies, e.g., UVM and OVM at basic levels. Cadence-IUS / Mentor-QuestaSim EDA Development Environment.

References:

1. SystemVerilog for Verification: A Guide to Learning the Testbench Language Features, Chris Spear, Publisher:Springer-Verlag New York, Inc. Secaucus, NJ, USA, 2006
2. Donald Thomas, **"Logic Design and Verification Using SystemVerilog**", CreateSpace Independent Publishing Platform, 2014.
3. Language Reference Manual for SystemVerilog.

Course Code	Course Title	Duration		L	T	P	C
MT17VS215	MEMS	14 Weeks	SC	4	1	0	5

Prerequisites

Engineering Physics, Upper Division standing in Engineering, Chemistry or Chemical Engineering and Material Science, VLSI Technology, Elements of Mechanical Engineering.

Course Objectives:

This course will enable students to:

1. Introduce the basic three pillars of MEMS design, fabrication and materials.
2. To introduce different materials used for MEMS.
3. To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
4. Highlight the various electrical and mechanical concepts with regards to MEMS arena.
5. Demonstrate the various fabrication and micro machining techniques.
6. Recognize the basic operation principles Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties.
7. Understand Etch mechanism, reactive Plasma Etching techniques and Equipment.
8. To introduce various sensors and actuators.

Course Outcomes:

On completion of this course the student will be able to:

1. Differentiate between micro systems, MEMS and NEMS
2. Assess the various electro-mechanical properties of materials used for MEMS design
3. Describe the various steps involved in the MEMS fabrication
4. Analyze the chemical and physical vapor processes; heteroepitaxy and defects; substrates and substrate engineering

5. Convey knowledge of advanced concepts of lithography and etching
6. Explore electrostatic, thermal, piezoelectric and magnetic actuators at micro scale

Mapping of Course Outcomes with programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P 7	PO8	PO9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
	CO 1	1		2		3		3					4	1		2
	CO 2	1			2	3		4		3				1		2
	CO 3	1	1	2		3	4	2						1		2
	CO 4	1		3			2					3	4	1		2
MT17VS215	CO5	1		3			2					3	4	1		2
	CO6	1		3			2					3	4	1		2

Course Contents:

Unit 1: Introduction to MEMS **[14]**

Overview of MEMS and Microsystems: What are MEMS, Why Miniaturization, Why microfabrication, Microsystems versus MEMS, Smart Materials, Structures and Systems, Integrated Microsystems, Typical MEMS and Microsystem Products, The Multidisciplinary nature of Microsystem design and manufacture, Applications of smart Materials and Micro Systems, Applications of Aerospace, Biomedical and Automotive industry.

Materials for MEMS: Silicon compatible material System-Silicon, Czochralski Crystal Growing, Silicon oxide and Nitride, Thin metal Films, Polymers, Other material and substrates.

Unit 2: Microsystems Fabrication Process: **[14]**

Epitaxy: Introduction, Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation.

Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. Photolithography, Ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, Some MEMS fabrication processes: surface micro-machining, bulk micromachining, LIGA process.

Unit 3: Microsystems Design and Packaging **[14]**

Assembly, Packaging, and Testing (APT) of Microsystems, Microsystem Packaging, overview of Mechanical Packaging of Microelectronics, interfaces in Microsystem Packaging, Essential Packaging Technologies, Three Dimensional Packaging, Assembly of Microsystems, Selection of Packaging Materials.

Unit 4: Micro Sensors, Actuators, Systems and Smart Materials **[14]**

Case studies – silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conduct metric gas sensor, silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-drive and magnetic micro relay, portable clinical analyzer, active noise control in a helicopter cabin.

VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Technology, IC Fabrication.

Text Books:

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat, V.K. Aatre, "**Micro and Smart Systems**", *Wiley India, 2010.*
2. Chang Liu, "**Foundation of MEMS**" *Pearson Education International, 2006.*
3. Tai Ran Hsu, "**MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering**, *Wiley, 2008*.

Reference Books:

1. S. M. Sze, **"VLSI Technology",** *McGraw-Hill, Second Edition.*
2. Nadim Maluf, Kirt Williams "**An Introduction to Microelectromechanical Systems Engineering"** Second addition.

Course Code	Course Title	Duration		L	T	P	C
MT17VS225	Advanced Computer Architecture	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Concepts of computer design, pipelining and instruction level parallelism.
2. Knowledge on design of memory hierarchy and real faults in a system.
3. Basic knowledge on very long instruction word and EPIC.
4. Concepts of multiprocessors and interprocessor communication.
5. Concepts of computer arithmetic.

Course Objectives:

1. Introduce the fundamentals of computer design.
2. Understand the quantitative principles of computer design and their performance.
3. Understanding the concepts of instruction level parallelism.
4. Introduce the fundamentals of advanced memory hierarchy.
5. Introduce the basics of VLIW processors.
6. Understand the concepts of multiprocessors and inter process communication.
7. Study of computer arithmetic blocks.

Course Outcomes:

On completion of this course the student will be able to:

1. Analyse the importance of power and performance for given computer architecture.
2. Identifying the pitfalls and fallacies for the performance in the computer architecture.
3. Describe the instruction level parallelism and its importance with respect to performance and power dissipation in computer architecture
4. Calculate the performance of I/O devices
5. Designing the efficient hardware and software for the VLIW processors.
6. Designing the efficient arithmetic components for computer architecture.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MT17VS 225	CO1	3		1				3					3	3	2	2
	CO2	2		2				3					3	3	2	1
	CO3	2		2				3					3	3	2	2
	CO4			3				3					3			2
	CO5	2		2				3					3	3	2	2
	CO6	2		2				3					3	3	2	2

Course Contents:

Unit 1: Introduction and Review of Fundamentals of Computer Design [14]

Introduction; Classes computers, Defining computer architecture, Trends in Technology, Trends in power in Integrated Circuits, Trends in cost, Dependability, Measuring, reporting and summarizing Performance, Quantitative Principles of computer design, Performance and Price-Performance; Fallacies and pitfalls; Case studies.

Some topics in Pipelining, Instruction –Level Parallelism, Its Exploitation and Limits on ILP:Introduction to pipelining, ILP; Crosscutting issues, fallacies, and pitfalls with respect to pipelining, Basic concepts and challenges of ILP, Case study of Pentium 4, Fallacies and pitfalls.

Introduction to limits in ILP, Performance and efficiency in advanced multiple-issue processors.

Unit 2: Memory Hierarchy Design, Storage Systems [14]

Review of basic concepts, Cross cutting issues in the design of memory hierarchies, Case study of AMD Opteron memory hierarchy, Fallacies and pitfalls in the design of memory hierarchies, Introduction to Storage Systems, Advanced topics in disk storage.

Definition and examples of real faults and failures: I/O performance, reliability measures, and benchmarks; Queuing theory; Crosscutting Issues, Designing and evaluating an I/O system – The Internet archive cluster; Case study of NetAA FAS6000 filer; Fallacies and pitfalls.

Unit 3: Hardware and Software for VLIW and EPIC Introduction [14]

Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64

Architecture and Itanium Processor, Concluding Remarks.

Unit 4:Large-Scale Multiprocessors and Scientific Applications Introduction, Interprocessor Communication [14]

The Critical Performance Issue, Characteristics of Scientific Applications, Synchronization: Scaling Up, Performance of Scientific Applications on Shared-Memory

Multiprocessors, Performance Measurement of Parallel Processors with Scientific Applications, Implementing Cache Coherence, the Custom Cluster Approach: Blue Gene/L, Concluding Remarks. Computer Arithmetic:Introduction, Basic Techniques of Integer Arithmetic, Floating Point, Floating-Point Multiplication, Floating-Point Addition, Division and Remainder, More on Floating-Point Arithmetic, Speeding Up Integer Addition, Speeding Up Integer Multiplication and Division, Fallacies and Pitfalls.

References:

1. Hennessey and Patterson, "**Computer Architecture A Quantitative Approach**", 4th Edition, Elsevier, 2007.
2. Kai Hwang, "**Advanced Computer Architecture - Parallelism, Scalability, Programmability**", 2nd Edition, 1992.

Semester – III:

Course Code	Course Title	Duration		L	T	P	C
MT17VS313	MSP430	14 Weeks	SC	4	0	1	5

Prerequisites:

1. Knowledge on basics of MSP430 architecture.
2. Concepts of Interrupts and Interfacing techniques in MSP430.
3. Basic knowledge of I^2C and serial communication.
4. Practical knowledge on MSP430 programming.

Course Objectives:

1. Study the introduction to the TI MSP430 family of microcontrollers, their architecture, peripheral features and programming.
2. Understand and Provide theoretical and practical aspects of low-power system development using the MSP430.
3. Know the peripheral features of the MSP430, which include timers, digital and analog IO and serial communication modules.
4. Understand and Present case studies of application of the MSP430 so that the student can handle embedded system design projects independently.
5. Know the applications of the MSP430 in embedded systems

Course Outcomes:

On completion of this course the students will be able to:

1. Design, develop, and evaluate software or a software/hardware system, component, or process to meet desired needs within realistic constraints.
2. Demonstrate and function on multi-disciplinary teams working in mechatronics and low power embedded systems.
3. Design, identify, formulate, and solve engineering problems
4. Analyse the need for, and an ability to engage in life-long learning and continuing professional development
5. Analyse a problem, and identify and define the computing requirements appropriate to its solution.
6. Design and develop principles in the construction of software systems of varying complexity.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO1	P 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
MT17VS 313	**CO1**	**3**	**1**	**1**	**1**			**3**					**3**	**3**	**2**	**2**
	CO2	**2**	**1**	**2**	**1**			**3**					**3**	**3**	**2**	**1**
	CO3	**2**	**1**	**2**				**3**					**3**	**3**	**2**	**2**
	CO4			**3**				**3**					**3**			**2**

	CO5	**2**	**1**	**2**				**3**					**3**	**3**	**2**	**2**
	CO6	**2**	**1**	**2**				**3**					**3**	**3**	**2**	**2**

Course Contents:

Unit 1:MSP430 Architecture and Programming **[14]**

Architecture of the MSP430, addressing modes, instruction set, development environment, MSP430 programming in C and assembly language.

Unit 2: Interrupts and Digital IO in the MSP430 **[14]**

Interrupts, interrupt service routines, low-power modes of operation, parallel ports, digital inputs, and outputs, driving heavier loads, liquid crystal displays, driving an LCD from an MSP430x4xx.

Unit 3: Timers and Analog IO in the MSP430 **[14]**

Watchdog timer, basic timer1, timer A, measurement in the capture mode, pulse-width modulation, modes of timer A and timer_B, comparator A, basic operation of the ADC10 and ADC12, the SD16_a sigma–delta ADC.

Unit 4:Communication Peripherals the MSP430 **[14]**

SPI and I²C features in MSP430, asynchronous serial communication, case studies of the applications of the MSP430 in embedded systems.

References:

1. John Davies, "**MSP430 Microcontroller Basics**", Newnes (Elsevier Science), 2008.
2. C P Ravikumar, "**MSP430 Microcontroller in Embedded System Project**," Elite Publishing House Pvt. Ltd., December 2011.
3. **MSP430 Teaching CD-ROM**, Texas Instruments, 2008.
4. Sample Programs for MSP430 downloadable from *www.msp430.com.*

Course Code	Course Title	Duration		L	T	P	C
MT17VS323	FPGA Based Embedded System Design	14 Weeks	SC	4	1	0	5

Prerequisites:

Concepts of digital system design and behavior modelling of a system, Basics of Verilog and VHDL, Knowledge of sequential and combinational circuits.

Course Objectives:

This course will enable students to:

1. Know FPGA architecture, interconnect and technologies.
2. Analyze the FPGA architecture and design implementation methodologies.
3. Explore the configuration, implementation and testing of embedded system on FPGA.

Course Outcomes:

After completion of the course a student will be able to:

1. Design the reconfigurable digital systems.
2. Demonstrate and Debug the embedded systems before the actual product is developed.
3. Design finite state machines for various applications.
4. Implement, Design and develop embedded system using FPGA and EDA tools.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CO1	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO2	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO3	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO4	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**

Course Contents:

Unit 1: Introduction **[14]**

Embedded System Overview, Hypothetical Robot Control System, Digital Design Platforms, Use of Pre-designed HDL Codes, Simulating Digital Logic Using Verilog

Unit 2: FPGA and CPLD **[14]**

Architecture of a FPGA, FPGA Interconnect Technology, Logic Cell, FPGA Memory, Clock Distribution and Scaling, Standards, Multipliers, Floor Plan and Routing, Timing Model for a FPGA, FPGA Power Usage

Unit 3: FPGA-based Embedded Processor **[14]**

Hardware–Software Task Partitioning, FPGA Fabric Immersed Processors, Soft Processors, Hard Processors, Tool Flow for Hardware–Software Co-design, Interfacing Memory to the Processor, Interfacing Processor with Peripherals, Types of On-chip Interfaces, Wishbone Interface, Avalon Switch Matrix, OPB Bus Interface, Design Re-use Using On-chip Bus Interface, Creating a Customized Microcontroller, Robot Axis Position Control

Unit 4: FPGA-based Signal Interfacing and Conditioning **[14]**

Serial Data Communication, Physical Layer for Serial Communication, RS-232-based Point-to-Point Communication, RS-485-based Multi-point Communication, Serial Peripheral Interface (SPI), Signal Conditioning with FPGAs, Prototyping Using FPGAs, Test Environment for the Robot Controller

Text Books:

1. Rahul Dubey, "**Introduction to Embedded System Design Using Field Programmable Gate Arrays**", Springer, 2008
2. Peter Ashenden, "**Digital Design using VHDL**", Elsevier, 2007.

3. Peter Ashenden, "**Digital Design using Verilog**", Elsevier, 2007.

Reference Books:

1. M.J.S. Smith, "**Application Specific Integrated Circuits**", Pearson, 2000.
2. W.Wolf, "**FPGA based system design**", Pearson, 2004.
3. Clive Maxfield, "**The Design Warriors's Guide to FPGAs**", Elsevier, 2004.

Course Code	Course Title	Duration		L	T	P	C
MT17VS333	Synthesis and Optimization of Digital Circuits	14 Weeks	SC	4	1	0	5

Prerequisites:

Basics of microelectronics, semiconductor technologies.

1. Concepts of system modelling and different optimizations of combinational logic circuit.
2. Knowledge on transformations, synthesis and delay calculation for combinational circuit.
3. Basics of scheduling algorithm.

Course Objectives:

1. To understand different methods used for the simplification of Boolean functions.
2. To understand and implement combinational, synchronous, and asynchronous sequential circuits.
3. To be acquainted with the MOS devices, system level design.
4. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits using computer aided synthesis.
5. To provide hands on experience to the concepts taught in class.

Course Outcomes:

On completion of this course the students will be able to:

1. Design combinational and sequential circuits
2. Differentiate between Mealy and Moore model state machines, and draw a block diagram of each.
3. Describe the operation of basic logic gates (NOT, NAND, NOR) constructed using N- and P-channel MOSFETs and draw their circuit diagrams.
4. Define logic gate fan-in and describe the basis for its practical limit.
5. Calculate the DC noise immunity margin of a logic circuit and describe the consequence of an insufficient margin.
6. Design and demonstrate some basic projects based on sequential design.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POS/ COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
MT17VS333	**CO1**	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO2	**3**	**3**			**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO3	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO4	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO5	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**
	CO6	**3**	**3**	**3**		**2**				**2**	**3**		**3**	**2**	**3**	**2**

Course Contents

Unit 1: Introduction [14]

Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization.

Graphs: Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.

Unit 2: Hardware Modeling [14]

Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, data flow and sequencing graphs, compilation and optimization techniques.

Two Level Combinational Logic Optimization: Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.

Unit 3: Multiple Level Combinational Optimizations [14]

Models and transformations for combinational networks, algebraic model, Synthesis of testable network, algorithm for delay evaluation and optimization, rule based system for logic optimization. Sequential Circuit Optimization: Sequential circuit optimization using state based models, sequential circuit optimization using network models.

Unit 4: Schedule Algorithms [14]

A model for scheduling problems, Scheduling with resource and without resource constraints, Scheduling algorithms for extended sequencing models, Scheduling Pipe lined circuits.

Cell Library Binding: Problem formulation and analysis, algorithms for library binding, specific problems and algorithms for library binding (lookup table F.P.G.As and Antifuse based F.P.G.As), rule based library binding.

References:

1. Giovanni De Micheli, "**Synthesis and Optimization of Digital Circuits**", Tata McGraw-Hill, 2003.
2. ZviKohavi, "**Switching and Finite Automata Theory**", Tata McGraw Hill, thirdedition,

2000.
3. Alan B.Marcovitz, “**Intro. To Logic Design**”, TMH, second edition, 2002.
4. Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer, “**Logic Synthesis**”, McGraw-Hill, USA, 1994.
5. Neil H.E. Weste and David money harris, “C**MOS VLSI Design: A circuits and system Perspective**”,fourth edition, Pearson Education (Asia) Pvt. Ltd., 2000.
6. Kevin Skahill, “**VHDL for Programmable Logic**”, Pearson Education (Asia) Pvt. Ltd., 2000.

Course Code	Course Title	Duration		L	T	P	C
MT17VS343	CMOS RF Circuit Design	14 Weeks	SC	4	1	0	5

Prerequisites:
1. Concepts of RF design and wireless technology.
2. Basic knowledge on RF modulation techniques.
3. Knowledge on behaviour and characteristics of BJT and MOSFET.

Course Objectives:
1. Understanding of the design and analysis of radio frequency integrated circuits and systems (RFICs) for communication.
2. Integrated Electronic Circuit Design which covers transistor-level design.

Course Outcomes:
On completion of this course the student will be able to:
1. Describe and understand the general challenges in the design of CMOS RF circuits.
2. Design matching circuits using passive RLC components.
3. Use various techniques to design high-frequency amplifiers.
4. Design and analyze oscillators.
5. Understand fundamentals of phase noise in oscillators.

Mapping of Course Outcomes with Programme Outcomes

Course Code	POs/ COs	PO1	PO2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
MT17VS343	**CO1**	**3**	**3**	**3**	**3**								**2**	**3**	**3**
	CO2	**3**	**2**	**2**	**3**								**2**	**3**	**3**
	CO3	**4**	**2**	**3**	**2**	**4**							**2**	**3**	**3**
	CO4	**3**	**3**	**3**	**3**	**2**		**2**					**3**	**3**	**3**
	CO5	**3**	**3**	**3**	**3**	**2**		**2**					**3**	**3**	**3**

Course Contents:

Unit 1: Introduction to RF Design and Wireless Technology **[14]**

Design and Applications, Complexity and Choice of Technology**.**
Basic concepts in RF design:Nonlinearly and Time Variance, Intersymbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion**.**

Unit 2: RF Modulation [14]

Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, direct conversion and two-step transmitters.

Unit 3: BJT and MOSFET Behavior at RF Frequencies [14]

BJT and MOSFET behavior at RF frequencies, modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation.

Unit 4: RF Circuits Design [14]

Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range,various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures
And frequency dividers, Power Amplifier design, Liberalization techniques, Design issues in integrated RF filters.

References:

1. B. Razavi, “**RF Microelectronics**” PHI 1998.
2. R. Jacob Baker, H.W. Li, D.E. Boyce “**CMOS Circuit Design, layout and Simulation**”, PHI 1998.
3. Thomas H. Lee “**Design of CMOS RF Integrated Circuits**” Cambridge University press 1998.
4. Y.P. Tsividis, “**Mixed Analog and Digital Devices and Technology**”, TMH 1996.

Course Code	Course Title	Duration		L	T	P	C
MT17VS314	Advances in VLSI Design	14 Weeks	SC	4	1	0	5

Prerequisites:

1. Concepts of MOS and CMOS circuits.
2. Knowledge on BICMOS, steering logic and buffers.
3. Differences between MOS and CMOS.
4. Concepts of various design methods in CMOS.

Course Objectives:

1. To understand the basics and operation of static, comparison between CMOS and BiCMOS.
2. To understand short channel effects.
3. To understand the challenges to CMOS.
4. To understand the super buffers, layouts and technology mapping.

Course Outcomes

On completion of this course the student will be able to:

1. Learn advanced technologies in the fields of VLSI design with the fundamental concepts.
2. Apply advanced technical knowledge in multiple contexts.
3. Understand and design advanced VLSI based system and analyse and interpret results.
4. Use the techniques, skills, modern Electronic Design

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COs	PO 1	P0 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	PSO 3
MT17VS314	**CO1**	1		2			3							3	1	2
	CO2		1	2			3							2	1	3
	CO3				2	1	3							3	2	1
	CO4		2	1	3											

Course Contents:

Unit 1: Review of MOS Circuits **[14]**

MOS and CMOS static plots, switches, comparison between CMOS and BI - CMOS.

Short Channel Effects and Challenges to CMOS: Short channel effects, scaling theory, processing challenges to further CMOS Miniaturization.

Unit 2: Beyond CMOS **[14]**

Evolutionary advances beyond CMOS, carbon Nanotubes, conventional vs. tactile computing, computing, molecular and biological computing - molecular Diode and diode- diode logic. Defect tolerant computing.

Super Buffers, Bi-CMOS and Steering Logic: Introduction, RC delay lines, super buffers- An NMOS super buffer, tri state super buffer and pad drivers, CMOS super buffers, Dynamic ratio less inverters, large capacitive loads, pass logic, designing of transistor logic, General functional blocks - NMOS and CMOS functional blocks.

Unit 3: Special Circuit Layouts and Technology Mapping **[14]**

Introduction, Talley circuits, NAND-NAND, NOR- NOR, and AOI Logic, NMOS, CMOS Multiplexers, Barrel shifter, Wire routing and module layout.

Unit 4: System Design **[14]**

CMOS design methods, structured design methods, Strategies encompassing hierarchy, regularity, modularity & locality, CMOS Chip design Options, programmable logic, Programmable inter connect, programmable structure, Gate arrays standard cell approach,
Full custom design.

References:

1. Kevin F Brennan "**Introduction to Semi-Conductor Device**", Cambridge publications, 2006.
2. Eugene D Fabricius "**Introduction to VLSI Design**", McGraw-Hill International publications, 1990.
3. D.APucknell. "**Basic VLSI Design**", PHI Publication, 2005.
4. Wayne Wolf, "**Modern VLSI Design**" Pearson Education, Second Edition, 2002.

Course Code	Course Title	Duration		L	T	P	C
MT17VS314	AUTOMOTIVE ELECTRONICS SYSTEM	14 Weeks	OE	3	1	0	4

Course Objectives:

1. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
2. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
3. Know the principles and functionalities of various Automotive Communication Protocols (ACPs), Design ACP based In-Vehicle Networks(IVNs), selection of ACPs for various application in Automotive
4. Know the industry standard practices for ECU design for automotive, modeling and analysis of application software for ECU design and development, design of ECUs for automobiles, design of HIL and fault diagnostics

Course Outcomes:

1. Implement and Interface sensors and for various automotive applications
2. Design and diagnose the faults in the systems Implement automotive fault diagnostics and faults
3. Analyze on and off board diagnostics, diagnostics protocol.

Mapping of Course Outcomes with Program Outcomes4.

Course Code	POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MT17VS314	CO1	2	1					2				3	1		2
	CO2	1	2	1		3			3				1		2
	CO3	1		1			2				3		1		2

Course Contents:

Unit 1: Automotive Industry and Modern Automotive Systems [14]

Vehicle classifications and specifications, need for electronics in automobiles, Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Spark and Compression Ignition Engines, Ignition systems, Spark plug, Spark pulse generation, Ignition Timing. Transmission Control - Automotive transmissions, Drive Train, Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling, Air Intake System, Lighting.

Unit 2: Introduction to Automotive Sensors and Instrumentation [14]

Sensors and actuators, Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor Sensors in Engine control, adaptive cruise control, braking control, traction control, steering, stability, Lighting, wipers, climate control, Sensors for occupant safety, Sensor and actuator interfacing techniques and electronic displays. Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator

Unit 3: Control Systems [14]

Exhaust After-Treatment Systems – AIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control Communication – Serial Data, Communication Systems, Power windows, Remote keyless entry systems, GPS,Automotive Communication Protocols Protection, Body and Chassis Electrical Systems, Remote Keyless Entry, Vehicle Motion Control – Cruise Control, Chassis, , Power Brakes, antilock braking systems, Electronic stability and other technologies, Traction Control, Electronic Stability Control, Electronically controlled suspension Fundamentals of electronically controlled steering system, Power Steering,

Unit 4: Safety and Convenience [14]

Electronics for Passenger Safety and Convenience – SIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems, Automotive Instrumentation – Sampling, Measurement & Signal Conversion of various parameters Integrated Body – Climate Control Systems, Electronic HVAC Systems, Lighting, Entertainment Systems Automotive Diagnostics – Timing Light, Engine

Analyzer, Process of Automotive Fault Diagnostics, Fault Codes, On-board diagnostics, Off-board diagnostics, Expert Systems. Future Automotive Electronic Systems – Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System, AFS.

Reference Books:

1. Denton. Burlington "**Automotive Electrical and Electronic Systems**", MA 01803, Elsevier Butterworth-Heinemann, 2004.
2. Ronald K. Jurgen. "**Automotive Electronics Handbook**", 2nd Edition, McGraw-Hill, 2007
3. Christian Kohler, "**Enhancing Embedded Systems Simulation**" Vieweg+TeubnerVerlag/ Springer, 2011.
4. Gabriela Nicolescu and Pieter J. Mosterman, "**Model-Based Design for Embedded Systems**", CRC Press, 2010
5. Gilbert Held, "**Inter- and Intra-Vehicle Communications**", CRC Press, 2007.
6. William B. Ribbens, "**Understanding Automotive Electronics**", 5th Edition, Newnes, 2006
7. Bosch, "**Automotive Electrics & Electronics**", Robert Bosch GmbH, 3rd Edition, 1999.

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Electronics and Communication Engineering is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Electronics and Communication Engineering also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and

Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The various skill/certification programs identified are as follows:

- Big-data and Cloud Computing, Internet of Things (IOT), Xilinx, NS-2, Cadence, ANSYS, Advanced C C++ and Internals of LINUX/UNIX
- Red-Hat certified programs on LINUX
- Management related programs like SAP, ERP and Business Analytics.
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration,
- IBM certified programs.

The University has signed MOU’s with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students’ exchange programs for higher learning and for conducting certification programs.

MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P.Shyama Raju
Chancellor
REVA University

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven engineering courses after studying the requirements of industries in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills to opt for different job prospects across the global.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of M.Tech in Digital Communication and Networking and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country.

I wish you every success in your career.

MESSAGE FROM THE HON'BLE VICE-CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the real world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care and after detailed market survey of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society. It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects. It facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.
The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the university. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing a brief information about M.Tech in Digital Communication and Networking, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed and to work hard and make use of enormous resources and expert faculties to accomplish all round development of their personalities and succeed with flying colours not only in earning degree but also in their future career as leaders and proud citizens of mother India.

Dr. S .Y . Kulkarni
Vice-Chancellor

MESSAGE FROM THE HON'BLE PRINCIPAL DIRECTOR

The curriculum of an institution of higher learning is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The curriculum of the B. Tech, M.Tech and other programs of REVA University is no exception.

An experience of a decade in preparing graduates and postgraduates in engineering, architecture, law, commerce and science for a wide variety of industries & research level organizations has led to creation of the new curriculum. I sincerely believe that it will meet the aspirations of all stake holders – students, faculty and the employers of the graduates and postgraduates of REVA University.

The curriculum has been designed in such a way that the teacher enjoys freedom to expand it in any direction he feels appropriate and incorporates the latest knowledge and stimulates the creative minds of the students. There is also provision for new experiments with new contents and new techniques. This is going to lead to new teaching – learning paradigm with experiential, experimental & industry relevant approaches. The present curriculum is contemporary because it is culmination of efforts of large number of faculty members, experts from industries and research level organizations. An effort of benchmarking this curriculum with curriculum of other institutions of repute like NITs and IITs has been done.

I am very sure that all students of REVA University enjoy this curriculum and take fullest advantage to expose themselves to fundamentals and applications. Also, imbibe all attributes that are required to term them as Global Engineers. The innovativeness and creativity being introduced should be explored fully by our students.

The flexibility in the curriculum permits staff and students to incorporate changes in terms of addition of new courses and deletion of irrelevant courses keeping the rapid advances in the technology into consideration.

I also record my personal gratitude to Chancellor, Vice chancellor and members of Academic Senate who have lent every bit of their wisdom to make this curriculum truly superior.

Dr. S.Y.Kulkarni
Principal Director - Academics

PREFACE

The M. Tech in Digital communication and Networking is designed keeping in view the current situation and possible future developments, both at national and international levels. This course is designed to give greater emphasis on Digital Communication and Engineering design with a flexibility to explore any of the implementation platform and application field through a number of soft core courses providing knowledge in these specialized areas. This facilitates the students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts and requisite skills.

During past three decades, the world has seen significant changes in the telecommunication industry. There has been rapid growth in wireless communication as seen by mobile systems, wireless communication has moved from first generation (1G) to fourth generation (4G). Wireless communication and Networking has emerged as an attractive option for graduates to specialize and develop their design skills for wireless system design, implementation and testing. The advantage for Wireless communication and network engineering students is that they are required across all electronic system development industries viz automotive, telecommunication, medical equipment's, automation etc. They are also required for software development for all wireless systems.

The program is designed to expose students to various courses having applications in wireless communication sector, antenna engineering, advanced computer networking device driver programming, mobile application development, wireless security etc. They are also exposed to basic concepts of MIMO technology, wireless testing and automation, wireless network standards, real time systems, network modeling, various system design platform such as ARM, low power microcontrollers and FPGA, through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, internships, certification programs, etc. in consultation with industries will be carried out. There is also a scope for cultural, social and community service activities for the students to shape their personality suitable for all-round development.

The Digital Communication and Networking students can choose their career in any communication and networking system development industries. Now a days almost every appliance is coming with some wireless system. The scope of wireless communication is very wide covering almost every home appliance industry, automotive, medical appliance manufactures, industry automation and control and telecommunication, data communication, Computer and Digital Systems, defense and space exploration.

I am sure the students choosing M Tech in Digital Communication and networking in School of Electronics and Communication Engineering in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Prof. Rajashekhar C. Biradar
Director
School of Electronics and Communication Engineering

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notch educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 9,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 22 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 42 acres of land equipped with state-of-the-art infrastructure and conductive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer center kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and other staff.

Currently, REVA University offers 18 Post Graduate programs and 8 Graduate programs in Engineering and Technology, Science, Commerce and Management in addition to research degrees leading to PhD in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education, in the years to come.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

ABOUT SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

The School of Electronics and Communication Engineering headed by a highly experienced Professor and is supported by well qualified faculty members. The school has the state-of-art class rooms and well equipped laboratories. It offers B.Tech and M.Tech programs in various specialized streams. The school also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry application oriented. The B. Tech program aims to prepare human resources to play a leading role in the continuing adventure of modern automated systems and communications. The Master degree programs focus on research and design in the core and IT industries, building and marketing the next generation of product development. This is reflected in various core subjects offered within the program. B. Tech program offers numerous choices of study for the students based on interest in the current state of art technology. Apart from fundamental courses in Electronics and Communication Engineering, the school facilitates to study in four streams such as Circuits and Devices, Communication Engineering, Signal Processing and Programming. Students are at liberty to choose from these streams in higher semesters. However, there is no restriction of cross migration from one stream to another at any level and thus there is a flexibility provided in the course duration.

The faculty members have number of publications in reputed national and international journals/conferences. The school is also involved in funded research projects. The other important features of the school are individual counseling of students for academic performance, additional coaching classes for important subjects for all the semesters, soft skill development classes, scientific and student centered teaching-learning process.

Student's welfare is given utmost priority here at School of Electronics and Communication Engineering. Advanced learning methods are adopted to make learning truly interactive. More focus is on discussion and practical applications rather than rote learning. Notes/handouts are given and critical thinking questions are asked to test understanding. Experienced, well qualified and friendly faculty members always strive hard to provide best of education to students.

Vision

The School of Electronics and Communication Engineering is envisioned to be a leading centre of higher learning with academic excellence in the field of electronics and communication engineering blended by research and innovation in tune with changing technological and cultural challenges.

Mission

- Establish a unique learning environment to enable the students to face the challenges of the Electronics and Communication Engineering field.
- Promote the establishment of centers of excellence in niche technology areas to nurture the spirit of innovation and creativity among faculty and students.
- Provide ethical and value based education by promoting activities addressing the societal needs.
- Enable students to develop skills to solve complex technological problems of current times and also provide a framework for promoting collaborative and multidisciplinary activities.

Program Educational Objectives (PEO's)

The programme educational objectives of the Electronics and Communication Engineering of REVA University is to prepare graduates

PEO-1	To have successful professional careers in national and multinational organization and communicate effectively as a member of a team orto lead a team.
PEO-2	To continue to learn and advance their careers throughactivities such asresearch and development, acquiring doctoral degree, participation in national level research programmes, teaching and research at university level etc.,
PEO-3	To be active members ready to serve the society locally and internationally, may takeupentrpreneurship for the growth of economy and to generate employment; and adopt the philosopy of lifelong learning to be aligned with economic and technological development.

Program Outcomes:

After successful completion of the programme, the graduates shall be able to

PO1. **Demonstrate in-depth knowledge** of Digital Communication Networking, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2. **Analyze complex engineering problems critically**, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3. **Think laterally and originally, conceptualize and solve engineering problems, evaluate** a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4. **Extract information pertinent to unfamiliar problems through literature survey and experiments**, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5. **Create, select, learn and apply appropriate techniques**, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

PO6. **Possess knowledge and understanding of group dynamics, recognize** opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7**. Demonstrate knowledge and understanding** of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8. **Communicate with the engineering community, and with society at large**, regarding **complex engineering activities** confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: **Recognize the need for**, and have the preparation and ability to engage in **life-long learning** independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10. **Acquire professional and intellectual integrity,** professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11. **Observe and examine critically the outcomes** of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback (**SELF learning**)

Programme Specific Outcomes (PSO's)

After successful completion of the programme, the graduates shall be able to

1. Isolate and solve complex problems in the domains of Digital Communication and Networking using latest hardware and software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions either independently or as a team
2. Implant the capacity to apply the concepts of wireless communications, advanced computer networks, network security, IoT and cyber physical systems, etc. in the design, development and implementation of application oriented engineering systems
3. Review scholarly work by referring journals, define a new problem, design, model, analyze and evaluate the solution and report as a dissertation in the area of Digital Communication and Networking

Board of Studies for School of Electronics and Communication Engineering

Sl. No.	Name, Designation & Affiliation	Status
1	**Dr. R. C. Biradar** Director, School of ECE, Reva University, Bangalore	**Chair Person**
2	**Dr. Rathna G. N.** Principal Research Scientist, E&E Dept., IISc., Bangalore	**Member**
3	**Dr.Kumar Shama** Professor, Dept. Of ECE, MIT, Manipal	**Member**
4	**Mr.Rajakrishnamoorthy** Director, Cognizant, Bangalore	**Member**
5	**Dr. K. S. Gurumurthy** Senior Professor, School of ECE, Reva University	**Member (Internal)**
6	**Dr. Venkata Siva Reddy** Professor, School of ECE, Reva University	**Member (Internal)**
7	**Dr. Bharathi S. H.** Professor, School of ECE, Reva University	**Member (Internal)**
8	**Prof.Jayaraman K.** Adjunct Professor, School of ECE,Reva University	**Member (Internal)**
9	**Dr. Geetha D. D.** Professor, School of ECE, Reva University	**Member (Internal)**
10	**Dr. P. I. Basarkod** Professor, School of ECE, Reva University	**Member (Internal)**

Advisory Board for School of Electronics and Communication Engineering

Sl. No	Name and affiliation
1	Dr. M.H.Kori, Technology Consultant, Technology Adviser Validus Technologies USA, Retd. Technical Director, Alcatel-Lucent Technologies, Bangalore
2	Dr. Vinod Sharma Professor, ECE Department, IISc. Bangalore
3	Dr. Surendra Pal Former ISRO Scientist, President, IETE-India, Bangalore
4	Dr. Shirshu Varma Professor, Department of Computer Science and Engineering IIIT Allahabad
5	Dr. Rathna Principal Research Scientist, Department of Electrical Engineering IISc., Bangalore
6	Dr. ArzadAlamKherani Samsung R and D, Bangalore
7	Dr. MahadevPrasanna Department of Electrical and Electronics Engineering IIT Guwahathi
8	Dr. Muralidhara Kulkarni Department of Electronics & Communication Engineering, NITK, Surathkal
9	Dr. Kumarashama Department of Electronics & Communication Engineering, Manipal Institute of Technology, Manipal
10	Dr.Vijayaprakash Department of Electronics & Communication Engineering, Bangalore Institute of Technology, Bangalore
11	Mr.Aravinda Sharma, Manager,Delphi Systems, Bangalore
12	Dr. Kashinath, Director ALS Semiconductors, Bangalore
13	Mr.LokeshaRai K,Director Symphony Telecca Services, Bangalore
14	Mrs.Deepa,Senior Engineer, Intel Corporation,Bangalore

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IFS, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Brief Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely,

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for **Lecture** session consisting of classroom instruction.
T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0 Course of Study and Duration:

The study of B Tech degree is grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning. In the teaching-learning process every **one hour session of L amounts to 1 credit per Semester.** In case of **T or P** minimum of **two hour session amounts to 1 credit or a three hour session amounts to 2 credits per semester of 16 weeks.**

The total duration of a semester is 20 weeks inclusive of semester-end examination.

A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

2.1. Various course of s**tudy** are labeled and defined as: (i) Core Course (CC), (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Foundation Course (FC):**
The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(iii) **Hard Core Course (HC):**
The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any that the candidates have to complete compulsorily.

(iv) **Soft Core Course (SC):**
A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(v) O**pen Elective Course:**
An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **FOUR to SIX** credits is called **Minor Project**work. A Minor Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be Earned:

3.1. A candidate has to earn 192 credits for successful completion of B Tech degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 32 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 192 credits in 8 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 192 credits for the B. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the B.Tech degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 192 credits for the B. Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B. Tech degree. The **add-on proficiency certification / diploma** so issued to the candidate contains the courses studied and grades earned.

5.0. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 componentsas C1, C2, and C3.**

The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component C1:

The first Component (C1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for C2 immediately after completion of process of C1.

The finer split - up for the award of marks in C1 is as follows:
Assignment / Seminar ……………………….. 5 marks for Unit 1&2
Test (Mid-Term) ……………….…………..20 marks for Unit 1&2
Total …………………………….…………..25 marks

(ii) Component C2:

The second component (C2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

The 17th week will be for revision of syllabus and preparation for the semester - end examination.
The finer split - up for the award of marks in C2 is as follows:
Assignment / Seminar …………………….. 5 marks for Unit 3 & 4
Review Test (Mid-Term) ………………….20 marks for Unit 3 & 4
Total ……………………………….……..25 marks

(iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

5.2. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for

5.3. The details of continuous assessment are summarized in the following table:

Component	Period	Syllabus	Weightage	Activity
C1	1st Week to 8th Week			Instructional process and Continuous Assessment
	Last 3 days of 8thWeek	First 50% (two units)	25%	Consolidation of C1
C2	From first day of 9th Week to first 3 days of16th Week			Instructional process and Continuous Assessment
	Last 3 days of 16th Week	Second 50% remaining two units	25%	Consolidation of C2
C3	17th Week			Revision and preparation for Semester–end exam(C3)
	18th Week to 19th Week	Entire syllabus	50%	Conduct of Semester-end Exams (C3)
	20th Week			Evaluation and Tabulation
	End of 20th Week			Notification of Final Grades

Note: Practical examination wherever applicable shall be conducted before conduct of C2 Examination. The calendar of practical examination shall be decided by the respective school.

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50).

5.4. Provision for Make- up Examination:

For those students who have secured less than 40% marks in end semester examination (C3) the university shall conduct a make-up examination after the end of every semester and before the commencement of next subsequent semester.

Such of those students who have secured more than 30% marks in C1 and C2 together and less than 40% marks in the End Semester Examination (C3) in a given course shall appear for make-up examination in that course.

A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance and performance requirements in C1 & C2 shall appear for make-up examination.

6.0. Re-Registration and Re-Admission:

In case a candidate fails in more than 4 courses in odd and even semesters together in a given academic year has to seek re-admission to those semesters during subsequent year within a stipulated period.

In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is not allowed to appear for end semester examination (C3) and he / she shall have to seek re-admission to that semester during subsequent year within a stipulated period.

6.1. In such case a candidate drops all the courses in semester due to personal reasons he / she can take re-admission to such dropped semester.

6.2 Provision to carry forward the failed subjects / courses:

The student who has failed in 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for C3 examination of failed courses of previous semesters concurrently with odd and even end semester examinations (C3) of current year of study. However, he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester.

Examples:-

1) Student "A" has failed in one course in first semester and 3 courses in second semester. He / she is eligible to seek admission for third semester and appear for C3 examination of one failed course of first semester concurrently with third semester C3 examination. Likewise, he / she is eligible to appear for C3 examination of 3 failed courses of second semester concurrently with fourth semester C3 examination. However, he / she has to clear all the failed courses of first and second semesters before seeking admission to fifth semester.

2) Student "B" has failed in two courses in third semester and two courses in fourth semester and has passed in all courses of first and second semesters. He / she is eligible to seek admission to fifth semester and appear for C3 examination of two failed courses of third semester concurrently with fifth semester C3 examination. Likewise he / she is eligible to appear for C3 examination of two failed courses of fourth semester concurrently with sixth semester C3 examination. However, he / she is not eligible to seek admission to seventh semester unless he / she passes in all the failed courses of third and fourth semesters.
3) Student "C" has failed in four courses in first semester but has cleared all the courses in second semester. He / she is eligible to seek admission for third semester and appear for C3 examination of four failed courses of first semester concurrently with third semester C3 examination. However, he / she is not eligible to seek admission for fifth semester unless he

/ she clears all the four failed courses of first semester.

7.0. Attendance Requirement:

a) All students must attend every lecture, tutorial and practical classes.

b) In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes attended.

c) Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (C3) examination.

d) Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

7.1. Absence during mid-semester examination:

In case a student has been absent from a mid-semester examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester examination.

7.2. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

8.0. Challenge Valuation

A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 07days after the announcement of the results. This challenge valuation is only for C3 component.

The answer scripts for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two

marks from first valuation and challenge valuation shall be the final.

9.0. Provisional Grade Card: The tentative / provisional grade card shall be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA). The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

9.1. Final Grade Card: Upon successful completion of B Tech Degree a Final Grade card consisting of Grades of all courses successfully completed by the candidatewill be issued by the Registrar (Evaluation).

9.2. The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	v*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Good; D-Fair; E-Satisfactory; F - Fail;

Here, P is the percentage of marks (P= [(C1+C2) +M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

9.3. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (192) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i.e. : **CGPA = ∑(Ci x Si) / ∑Ci**

Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.10 x 10 = 81.0

10.0 Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	**FGP**	
	Numerical Index	**Qualitative Index**
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

11.0. Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, and test papers etc., which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

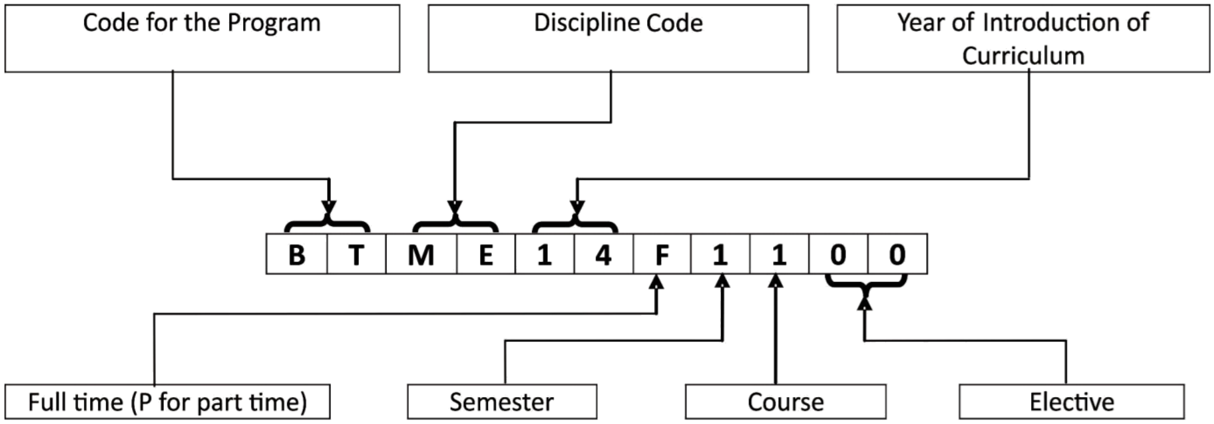
11.1. Grievance Cell:

For every program there will be one grievance cell. The composition of the grievance cell is as follows.

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

11.2. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBM (Bachelor of Business Management)	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, BS (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering /
MA	Master of Arts	DE	Data Engineering and Cloud Computing
MB	MBA (Master of Business Administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

M.Tech. (Digital Communication and Networking)

FULL-TIME

Eligibility for Admission:

The eligibility criteria for admission to M Tech Program of 2 years (4 Semesters) are given below:

B.E./B.Tech. in ECE/ TE/ CSE/ ISE/ Instrumentation Technology/ Medical Electronics/ Electrical and Electronics Engineering/ M Sc in Electronics with a minimum of 45% (40% in case of candidates belonging to SC and ST) marks in aggregate of any recognised university/institution or any other qualification recognized as equivalent there to.

Scheme of Instructions

2017-19

Sl No	Course Code	Course Title	HC/SC/OE	Credit Pattern			
				L	T	P	Total
		FIRST SEMESTER					
1	MTDC16F1100	Advanced Digital Communications	HC	4	0	1	5
2	MTDC16F1200	Advanced Computer Networks	HC	4	0	1	5
3	MTDC16F1300	Applied Mathematics For Communication Engineers	HC	4	1	0	5
4	MTDC16F1410	Error Control and Coding	SC	4	1	0	5
	MTDC16F1420	Antenna Design and Diversity		4	1	0	
5	MTDC16F1510	Wireless Sensor Network	SC	4	1	0	5
	MTDC16F1520	Network Modeling and Simulation		4	1	0	
		Total Credits					**25**
		SECOND SEMESTER					
1	MTDC16F2100	Channel Estimation and MIMO OFDM	HC	4	0	1	5
2	MTDC16F2200	Wireless Network Technology	HC	4	0	1	5
3	MTDC16F2310	Wireless Security	SC	4	1	0	5
	MTDC16F2320	Application Development		4	1	0	
	MTDC16F2330	Optical Communication And Networks		4	1	0	
4	MTDC16F2410	RF And microwave circuits	SC	4	1	0	**5**
	MTDC16F2420	Linux Kernel Programming		4	1	0	

	MTDC16F2430	Wireless Network standards		4	1	0	
	MTDC16F2430	DSP Algorithms for Communication Engg		4	1	0	
5	MTDC16F2510	Digital Audio and Video Broadcasting	SC	4	1	0	5
	MTDC16F2520	Consumer and Entertainment Electronics		4	1	0	
	MTDC16F2530	Network Programming		4	1	0	
		Total Credits					**25**
THIRD SEMESTER							
1	MTDC16F3110	Internet of Things- Practical Approach	SC	4	1	0	5
	MTDC16F3120	Communication system Design using FPGA		4	1	0	
	MTDC16F3130	Wireless Testing and Automation		4	1	0	
2	MTDC16F3200	Automotive Electronics Systems	OE	4	0	0	4
3	MTDC16F3300	Seminar/Certification Program	HC	4	1	0	5
4	MTDC16F3400	Internship/Mini Project	HC	0	2	8	10
		Total Credits					**24**
FOURTH SEMESTER							
1	MTDC16F4100	Project work and Dissertation	HC	0	2	20	22
		Total Credits					**22**
	Total Credits for four Semesters						**96**

Note: The courses in third semester will be self-study electives.

HC = Hard Core: SC= Soft Core: OE = Open Elective;

Detailed Syllabus

Semester I

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1100	**AdvancedDigital Communications**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Prerequisites:

Fundamentals of Communication, Transmission line, Coding Techniques, Fourier series

Course Objectives:

1. To understand the advanced concepts in digital communications. To Study the numerical, analytical and logical problem solving skills in digital communications.
2. To learn computer simulations of digital communications scenarios. To know the concepts of single and multichannel
3. To understand the concept of single and multicarrier system.
4. To study the spectral efficiency windowing in OFDM systems.

Course Outcomes

On completion of this course the student will be able to:

1. Identify and describe different techniques in modern digital communications, in particular source coding, modulation and detection, carrier modulation, and channel coding. (a,b,c)
2. Describe the concept of equalization and apply to design suitable equalizers for digital communication channels.(a,b,d)
3. Apply mathematical modeling to problems in digital communications, and explain how this is used to analyze and synthesize methods and algorithms within the field. (a,b,d)
4. Analyze multichannel and multicarrier systems .(a,b,d)
5. Differentiate single channel and multichannel systems .(a,b,d)
6. Present the concepts of OFDM cases studies.(a,b,d)
7. Distinguish CDMA and hybrid OFDM .(a,b,e)
8. Use a mathematical model to solve a given engineering problem in the field, and analyze the result and its validity. (a,b,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
	CO1	1	2	2									**1**		**2**
	CO2	1	2		3									2	3
	CO3	1	2		**3**								**2**	2	**1**
	CO4	1	3		**2**								**2**	2	**1**
MTDC16F1	**CO5**	1	2		**2**								**1**		**2**

100	**CO6**	1	1		**3**								1	2	
	CO7	1	2			**2**							2		**3**
	CO8	2	2		**3**								2	1	**3**

Course Contents:

UNIT 1:Digital Modulation techniques [14]

Review of digital modulation techniques**,** Power Spectra, Bandwidth Efficiency, formats viewed in the Light of the channel capacity Theorem, Effect of Intersymbol Interference, Bit Versus Symbol Error Probabilities, Synchronization, Applications, Performance evaluation of different digital modulation techniques using MATLAB

UNIT 2:Band-limited linear filter channels [14]

Optimum Receiver for channels with ISI and AWGN, Linear equalization, decision-feedback equalization, reduced complexity ML detectors, Iterative equalization and decoding, turbo equalization, adaptive equalization, Blind Equalization, Comparison of Equalizers MATLAB

UNIT 3: Multichannel and multicarrier systems [14]

Multichannel digital communications in AWGN channels, multicarrier communications. Orthogonal FDM**:** Single vs multicarrier systems, OFDM block diagram and its explanation, OFDM signal and its mathematical representation, selection parameters for modulation, pulse shaping in OFDM signal and spectral efficiency, synchronization in OFDM, pilot insertion, Peak to Average power ratio in Multicarrier Modulation. MATLAB simulation of OFDM

UNIT 4: Spread Spectrum Signals for Digital Communication [14]

Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals, Frequency-Hopped Spread Spectrum Signals, CDMA, time-hopping SS, Synchronization of SS systems.

Reference books:

1. John G Proakis and MasoudSalehi, “**Digital Communication**”, McGraw-Hill, 5th edition 2007.
2. Bernard Sklar and Pabitra Kumar Ray, “**Digital Communications**’’, Pearson, 2001.
3. Hwei Hsu, “**Schaum’s outline of theory and problems of Analog digital communications**”, McGraw Hill, 2nd edition, 2003.
4. WON Y Yang, Yong S Cho,“**MATLAB/Simulink for Digital Communication**“,Hongrung Publishing Korea, 2nd edition, 2012.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1200	**Advanced Computer Networks**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Prerequisites:

Computer networks, knowledge of any software language

Course Objectives:

1. To become familiar with the basics of Computer Networks.
2. To learn Network architectures.
3. To learn Concepts of fundamental protocols.
4. To gain the knowledge of internetworking concepts.
5. To understand the knowledge of internetworking concepts in various applications.
6. To acquire knowledge of implementation concepts in congestion control and error detections.

Course Outcomes:

Students will be able to:

1. Classify network services, protocols and architectures, explain why they are layered. (a,b,d)
2. Knowledge on key Internet applications and their protocols, and ability to develop their own applications. (a,b, d)
3. Using the sockets API. (a,b,f)
4. Practical knowledge gained by hands-on sessions. (a,c, f)
5. Gain the knowledge of application layer protocol. (a,c,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1200	CO1	1	1		**2**								**1**		**2**
	CO2	2	1		3								**1**	2	
	CO3	1	1				**2**						**2**	2	
	CO4	2		2			**3**						**2**	2	
	CO5	1		2			**2**						**1**	2	

Course Contents:

UNIT1:Foundations of Computer Networks [14]

Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop and-Wait , Sliding Window, Concurrent Logical Channels.

UNIT 2:Internetworking **[14]**

Switching and Bridging, Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork ?, Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.

UNIT- 3:Advanced Internetworking **[14]**

Network as a Graph, Distance Vector(RIP), Link State(OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems(BGP), IP Version 6(IPv6), Multicast Addresses, Multicast Routing (DVMRP, PIM, MSDP), Multiprotocol Label Switching (MPLS)

UNIT- 4:End-to-End Protocols **[14]**

Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.

Reference books:

1. Larry Peterson and Bruce S Davis "**Computer Networks: A System Approach**", Elsevier, 5th Edition, 2014.
2. Douglas E Comer, "**Internetworking with TCP/IP, Principles, Protocols and Architecture**", PHI, 6th Edition, 2014
3. Uyless Black "**Computer Networks, Protocols, Standards and Interfaces**", PHI, 2nd Edition 2009.
4. Behrouz A Forouzan "**TCP/IP Protocol Suite**", Tata McGraw-Hill, 4th Edition 2010.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1300	**Applied Mathematics for Communication Engg.**	**16 Weeks**	**HC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of matrices, basics of probability and knowledge of communication systems

Course Objectives:

1. To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.

2. To formulate and construct a mathematical model for a linear programming problem in real life situation
3. To expose the students to solve ordinary differential equations by various techniques.

Course Outcomes

On completion of this course the student will be able to:

1. To achieve an understanding of the basic concepts of algebraic equations and method of solving them. (a,b)
2. To familiarize the students with special functions and solve problems associated with engineering applications. (a, b,c)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1 300	**CO1**	2	3										**2**	**3**	
	CO2	2	3	3									**2**	2	

Course Contents:

UNIT 1:Linear Algebra **[14]**

Vector spaces - norms , Inner Products , Eigen values using QR transformations, QR factorization, generalized eigenvectors, Canonical forms, singular value decomposition and applications, pseudo inverse, least square approximations,,Toeplitz matrices and some applications.

UNIT 2: Linear Programming **[14]**

Formulation – Graphical solution , Simplex method , Two phase method , Transportation and Assignment Models process.

UNIT 3:Ordinary Differential Equations **[14]**

RungeKutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep methop, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT 4: Queueing **[14]**

Poisson Process, Markovian queues, Single and Multi-server Models, Little's formula , Machine Interference Model, Steady State analysis, Self Service queue.

Reference books:

1. P.Z.Peebles, "**Probability, random variables and random signal principles**'', TMH, Second edition.
2. S.U. Pillai and A. Papoulis, "**Probability, Random Variables and Stochastic Processes**", Mc Graw Hill, 4th edition, 2002.

3. Gilbert Strang, "**Linear Algebra and its applications**", Thomson Learning Asia, 2003.
4. Kenneth Hoffman and Ray Kunze, "**Linear Algebra**", Pearson education Asia, 2004.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1410	**Error Control and Coding**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:
Fundamentals of digital communication. Knowledge of source, source coding and probability theory and Basics of encoder/decoder

Course Objectives:
1. To understand the need for error correcting codes in data communication and storage systems.
2. To study the codes capable of correcting a specified number of errors.
3. To know the mathematical tools for designing error correcting codes, including finite fields.
4. To study the coding techniques of block codes, cyclic codes and convolution codes.

Course Outcomes
On completion of this course the student will be able to:
1. Generate Line codes, parity check matrices. (a,d)
2. Design encoding and multiplication circuits. (a,b,c)
3. Demonstrate Meggitt decoder, Error trapping decoding, Cyclic Hamming codes. Shortened cyclic codes. (a,c,d)
4. Implement Galois field arithmetic and Error correction. (a,c, d)
5. Explain Structural properties, Distance properties of Viterbi decoding algorithm. (a,b,c,d,e,f)
6. Demonstrate Concatenated coding schemes with Convolution inner codes. (a,b, d,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1410	**CO1**	2			**2**								**2**	**1**	
	CO2	2	2	3									**2**	3	1
	CO3	2		2	**3**								**2**	3	
	CO4	2		3	**3**								**3**	3	
	CO5	1	1	1	**2**	**2**	**3**						**1**	2	
	CO6	2	2		**2**		**3**						**2**	1	

Course Contents:

UNIT 1: Linear Block Code and Cyclic Codes **[14]**

Introduction, Generator and parity check Matrices, for Linear codes, Encoding circuits, Syndrome and Error Detection, Minimum distance consideration, Error detecting and Error correcting capabilities, Standard array and syndrome decoding, Decoding circuits, Hamming codes Reed-Muller codes, Golay code, pro trapping deduct codes and interleaved codes.

Generator and parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes- Encoding using Feedback shift register circuits, Generator matrix for cyclic codes. Syndrome computation and error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes. Shortened cyclic codes.

UNIT 2: BCH **[14]**

Binary primitive BCH codes, Decoding procedures, implementation of Galois field arithmetic, Implementation of Error correction. Non-binary BCH codes: q-array linear block codes, primitive BCH codes over GF(q),Reed-Solomon Codes, Decoding of Non- Binary BCH and RS codes: The Berlekamp-Massey Algorithm.

UNIT 3: Convolution Codes **[14]**

Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi decoding algorithm for decoding , Soft-output Viterbi Algorithm, Stack and Fano sequential decoding algorithms, Majority logic decoding

UNIT- 4: LDPC and Turbo Codes **[14]**

Low density parity check codes, Concatenated Codes, Turbo Codes, Burst – Error- Correcting Codes: Single level Concatenated codes, Multilevel concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolution inner codes, Introduction to Turbo coding and their distance properties, Design of turbo codes.

Recent trends in the related areas from journals, Conference proceedings Book chapters.

Reference books:

1. Shu Lin and Daniel J. Costello, Jr. "**Error Control Coding**", Pearson, Second Edition, 2004.
2. Blahut R. E. "**Theory and practice of Error Control Codes**", Addison Wesley, 1984

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1420	**Antenna Design and Diversity**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Analog communication

Course Objectives:

1. Provide an understanding of advanced antenna structures and their applications.
2. Apply the analysis and design of many antenna structures such as Broadband Antennas Frequency Independent Antennas, Aperture Antennas, Horn Antennas, Microstrip antennas, and Reflector antennas.
3. Provide a solid background to conduct research in the field of antenna analysis and design.

Course Outcomes

On completion of this course the student will be able to:

1. Understand important and fundamental antenna engineering parameters and terminology.(a,c,d)
2. Learn the basic concepts of electromagnetic wave radiation and reception. (a,c,d)
3. Develop the basic skills necessary for designing a wide variety of practical antennas and antenna arrays. (a,b,c,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1 420	CO1	1		2	**3**								**1**	**2**	**1**
	CO2	1		1	2								**1**	1	2
	CO3	2	2	3			**3**						**2**	3	**3**

Course Contents:

UNIT 1:Aperture Antennas **[14]**

Radiation Equations, Rectangular Apertures: Uniform Distribution on an infinite ground plane, Uniform distribution in Space, Circular Apertures: Uniform Distribution on an infinite ground plane, Design Considerations.

Antennas for Wireless Communication I: Helical, Normal mode, Axial mode, Design procedure, feed design for helical antenna, Horn Antenna; E-Plane, H-Plane, Pyramidal horn, Whip antenna, Discone antenna

UNIT 2:Antennas for Wireless Communication II **[14]**

Microstrip antenna – Basic Characteristics, Feeding Methods, Method of analysis, Transmission line model and cavity model for rectangular patch antenna, Circular Patch Antenna, Inverted F Antenna, Planar Spiral Antenna.

Antenna Arrays:

Two element and N-element arrays, Linear array with uniform, Binomial distribution and Tchebyscheff distribution, Planar array, Phased array, Adaptive arrays

UNIT 3: Diversity Schemes **[14]**

Macroscopic diversity scheme, Microscopic diversity scheme – Space diversity, Field diversity, Polarization diversity, Angle diversity, Frequency diversity and time diversity scheme

Combining Techniques:

Combining techniques for Macroscopic diversity, Combining techniques for Microscopic diversity – Selective combining, Switched combining, Maximal ratio combining, equal gain combining and feed combining technique.

UNIT 4:Smart Antenna **[14]**

Introduction, Benefits of Smart Antennas, Structures for Beam forming Systems, Strategies for the coverage and Capacity Improvement, Smart Antenna Algorithms.

HFSS Design procedure for different micro strip antennas

Reference Books:

1. C. A. Balanis, "**Antenna Theory Analysis and Design"**, John Wiley, 2nd Edition, 1997
2. Kraus, "**Antennas"**, McGraw Hill, TMH, 3rd/4th Edition, 1988.
3. T. K. Sarkar, Michael C. Wicks, M. Salazar-Palma, Robert J. Bonneau , " **Smart Antennas**", 2005, 3rd Ed, John Wiley and Sons Incutzman and Thiele, "**Antenna Theory and Design**", 3rd Ed, John Wiley and Sons Inc, 2013.
4. J. H. Reed, "**Software Radio A Modern Approach to Radio Engineering"**, Pearson Edu, 2010
5. Sachidanandaet. al, "**Antenna and Propagation"**, Pearson Edu, 2010.
6. R. Garg, Bhal and Bhartia , "**Microstrip Antenna Design Handbook**" , Artech House

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1510	**Wireless Sensor Network**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge Analog and Digital Communication, Probability and Information Theory, fundamentals of Wireless communication

Course Objective:

1. To study the emerging field of wireless sensor networks, which consist of many tiny, low-power devices equipped with sensing, computation, and wireless communication capabilities.
2. To understand operating systems, radio communication, networking protocols,
3. To comprehend the time synchronization, localization, energy management in Wireless sensor network

4. To know the programming abstractions, mobility, and applications of wireless sensor network

Course Outcomes

On completion of this course the student will be able to:

1. Analyze low-power devices equipped with sensing, computation, and wireless communication capabilities. (a,b,c)
2. Describe the operating systems, radio communication, networking protocols. (a,b,c)
3. Apply time synchronization, localization, energy management in Wireless sensor network (a,b,c,f)
4. Explain the programming abstractions, mobility, and applications of wireless sensor network (a,b,c)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1 510	**CO1**	1	2	2									**1**	**2**	
	CO2	2	2	1									**2**	2	1
	CO3	2	2	3			**3**						**2**	3	
	CO4	2	1	2									**3**		**1**

Course Contents:

UNIT 1:Overview of Wireless Sensor Networks & **Architectures** **[14]**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT 2: Networking Sensors **[14]**

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT 3: Infrastructure Establishment **[14]**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT 4: Sensor Network Platforms and Tools **[14]**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level Software platforms, Node-level Simulators, State-centric programming. Recent trends in the related areas from journals, Conference proceedings Book chapters.

Reference books:

1. Holger Karl and Andreas Willig, “**Protocols and Architectures for Wireless Sensor Networks**", John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, “**Wireless Sensor Networks- An Information Processing Approach**", Elsevier, 2007.
3. KazemSohraby, Daniel Minoli, &TaiebZnati, “**Wireless Sensor Networks-Technology, Protocols, and Applications**”, John Wiley, 2007.
   Anna Hac, “**Wireless Sensor Network Designs**”, John Wiley, 2003

Course Code	Course Title	Duration		L	T	P	C
MTDC16F1520	**Network Modelling and Simulation**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of computer networks. Network protocol, Probability and Random Process

Course Objective:

1. To understand the benefits of simulation and modeling in a range of important application areas.
2. To study simulation software to understand event –scheduling, Time-advance algorithm in computer networks.
3. To study the Essentials of Probability and Random Process
4. To understand Discrete Event Stochastic Models and Queuing Models
5. To learn the concepts of simulation for the various layers.

Course Outcomes

On completion of this course the student will be able to:

1. Analyze the concepts of simulation for systems. (a,b,d)
2. Describe the role of important elements of simulation and modeling paradigm. (a,c,d)
3. Apply the mathematical techniques to model and analyze structural and dynamical properties of Discrete-Event systems. (a,b,c)
4. Describe Output analysis for discrete-event simulation algorithms. (a,c,d)
5. Implement and apply simulation on various layers for Optimization.(a,c,d,f)
6. Present the Modeling techniques for event systems. (a,b,c,d,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F1520	**CO1**	1	2		**2**								**1**	**2**	
	CO2	1		2	1								**1**	1	
	CO3	2	2	2									**2**		**2**
	CO4	1		1	**2**								**1**	1	**2**
	CO5	2		2	**2**		**3**						**2**	2	**3**
	CO6	2	1	2	**2**		**3**						**2**		**2**

Course Contents:

UNIT 1: Introduction **[14]**

Importance of Network simulation, Areas of application, Systems and system environment; Components of a system, Discrete and continuous systems, Model of a system; Types of Models; Discrete-Event System Simulation. Simulation examples: Simulation of queuing systems; Simulation of inventory systems; other examples of simulation. What is model? Advantages and Disadvantages of Modeling and Simulation, Common Pitfalls of Modeling and Simulation and Rules of Thumb, Overview of M&S tools.

Simulation Software: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling; List processing.

UNIT 2: Statistical& Queuing Models **[14]**

Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions. Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.

UNIT 3:Random-Number Generation, Random-Variate Generation **[14]**

Properties of random Numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers.Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; selecting input models without data; Multivariate and Time-Series input models.

UNIT 4:Verification and Validation of Simulation Models, Optimization **[14]**

Model building, verification and validation; Verification of simulation models; Calibration and validation of models. Optimization via Simulation. Recent trends in the related areas from journals, Conference proceedings Book chapters.

Modeling and Simulation using NS2: RF Propagation Wired MACs, Network Layer.

Reference books:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, **''Discrete-Event System Simulation''**, Pearson Education, 4th Edition, 2007.
2. Jack L. Burbank, William Kasch and Jon Ward, "**An Introduction to Network Modeling and Simulation for the Practicing Engineer**", Wiley publication, 2011.
3. Lawrence M. Leemis and Stephen K. Park, ''**Discrete – Event Simulation A First Course**'', Pearson Education/PHI, 2006.
4. Averill M. Law, "**Simulation Modeling and Analysis**'', Tata McGraw-Hill, 4^{th} Edition, 2007.

Semester – II

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2100	**Channel Estimation and MIMO OFDM**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Prerequisites:

Fundamentals of wireless communication, propagation, linear algebra

Course Objectives:

1. To understand an overview of the wireless channel and its detailed characterization in the form of mathematical and statistical models.
2. To be acquainted with all the available channel estimation and equalization methods presently used in a wireless receiver system.
3. To understand linear channel estimation and equalization.
4. To get an understanding of the MIMO systems and their mathematical characterizations with respect to channel information and available efficient coding strategies.
5. To study smart antennas and MIMO-OFDM.

Course Outcomes

On completion of this course the student will be able to:

1. Calculate the path loss for wireless communication. (a,c,d)
2. Develop mathematical model for various types of wireless channels. (a,b,d)
3. Analyze different types of channel estimation and channel equalization. (a,b,d)
4. Describe MIMO based architecture. (a,b,c)
5. Estimate fading in MIMO multiple path. (a,b,d,i)
6. Develop mathematical modeling for MIMO channel. (a,b,c)
7. Use a mathematical model to solve a given engineering problem in the field, and analyze the result and its validity.(a,b,d,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
	CO1	2		2	1								2	2	
	CO2	2	2		3								2	2	3
	CO3	1	3		3								2	2	
MTDC16F2 100	CO4	1	2	1									1	2	
	CO5	1	1		2					2			1	2	1
	CO6	2	2	2									2	3	3
	CO7	2	3		3		3						1	2	3

Course Contents:

UNIT 1: Wireless Channel and Modeling **[14]**

Free space path loss, Two ray model, Empirical Path loss models, Shadow fading, Log Normal shadowing, Statistical channel models: Narrowband and wideband fading models, Space time channel models

UNIT 2: Channel estimation **[14]**

Characterization of fading multipath channels, Effect of signacharacterstics the choice of channel model, The Rake Demodulator, tapped delay line channel Model, performance of RAKE demodulator.

UNIT 3: Fading Channels Capacity **[14]**

Capacity of fading channels, coding for fading channels, Trellis coded modulation for fading channels, Bit Interleaved coded Modulation, and Super position coded Modulation.

UNIT 4:MIMO Channel Modelling **[14]**

MIMO channel modeling, MIMO channel measurement, MIMO channel capacity, cyclic delay diversity, Space time coding, MIMO-OFDM. Definition of spatial multiplexing: physical modeling of MIMO channels, LOS SIMO channel, LOS MISO channel, Modeling MIMO fading channels: basic approach, MIMO multipath channel.

Reference books:

1. John G Proakis and MasoudSalehi, "**Digital Communication**", McGraw-Hill, 5th edition 2007
2. Andrea Goldsmith, "**Wireless Communications**", Cambridge University Press, 2005.
3. David Tse and P.Viswanath, "**Fundamentals of Wireless Communication**", Cambridge, 2006.
4. UpenDalal, "**Wireless Communication**", Oxford, 2009.
5. Ke-Lin Du and M.N.S Swamy, "**Wireless Communication Systems**", Cambridge University Press, 2010.
6. Theodore S. Rappaport, "**Wireless Communications: Principles and Practice**", Prentice Hall, 2nd Edition, 2002.
7. Ali H. Sayed, "**Fundamentals of adaptive filtering**'', Wiley, IEEE press 2003

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2200	**Wireless Network Technology**	**16 Weeks**	**HC**	**4**	**0**	**1**	**5**

Prerequisites:

Wireless communication, probability and information theory, fundamentals of wireless networks

Course Objectives:

1. To understand basics of Wireless 4G LTE (Long Term Evolution), OFDM Transmission.
2. To Study physical layer for downlink.
3. To Understand Wireless Ad Hoc Networks, Wireless mesh Networks, VANETS.
4. To Understand Broadband Wireless Access and Wireless Body Area Networks.

Course Outcomes

On completion of this course the student will be able to:

1. Explain basics of Wireless 4G LTE (Long Term Evolution), OFDM Transmission. (a,b)
2. Design the physical layer for downlink. (a,b)
3. Describe Wireless Ad Hoc Networks, Wireless mesh Networks, VANETS. (a,b)
4. Present salient features of Broadband Wireless Access and Wireless Body Area Networks. (a,b,c)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COs	PO 1	P 2	PO 3	PO 4	PO 5	PO 6	P 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
MTDC16F2 200	**CO1**	1	2										**1**	**2**	
	CO2	2	3										**2**	2	
	CO3	2	2										**2**	1	
	CO4	1	2	2									**1**	2	

Course Contents:

UNIT 1: Introduction to LTE **[14]**

3G review, The context for the long term evolution, Requirements and targets for the long term evolution, 4G Technologies , Network architecture and protocols: Introduction, overall architecture overview, protocol architecture,

UNIT 2: Wireless AD HOC Networks **[14]**

Wireless Ad Hoc Networks, Mobile Ad Hoc Networks, Wireless Sensor Networks Wireless Mesh Networks, Vehicular Ad Hoc Networks (VANETs), A Survey on Multi-hop Vehicular Ad Hoc Networks under IEEE 802.16 Technology, communications in Vehicular Networks. Modeling and simulation of vehicular networks: Towards realistic and efficient models

UNIT3: Wireless Body Area Networks **[14]**

Wireless body area networks (WBAN), Network Architecture, Network components, design issues, Network protocols, WBAN technologies, WBAN applications.BROAD BAND WIRELESS ACCESS: Introduction to broad band wireless access, WIMAX Genesis and framework, Protocol layers and topologies

UNIT 4: Advanced wireless Networks **[14]**

Wireless Personal area networks (IEEE802.15.x protocols, e.g., Bluetooth, ZigBee); Local area networks (IEEE 802.11x protocols); Metropolitan area networks (LTE, WiMax) Mobile network

architectures (Mobile IP, mobile ad-hoc networks, delay-tolerant networks), Near Field Communication and networks , Introduction to 5G Technology
Recent trends in the related areas from journals, Conference proceedings, Book chapters.

Reference books:

1. StefaniaSesia, IssamToufik and Matthew Baker,"**LTE-The UMTS Long Term Evolution**" from theory to practice, John Wiley & sons ltd, 2009
2. Dr. Sunilkumar S Manvi and Mahabaleshwar S Kakkasageri, "**Wireless and Mobile Networks Concepts and Protocols**", Wiley India, 2010.
3. Loutfinuaymi, "**WIMAX Technology for wireless Broadband Wireless Access**", Wiley, 2007.
4. Xin Wang, "**Mobile AdHoc Networks Applications**", inteo, 2011.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2310	**Wireless Security**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:
Knowledge of communication theory, information theory, probability and random process

Course Objectives:

1. Study the system security issues in wireless systems, including satellite, terrestrial microwave, military tactical communications, and public safety, cellular and wireless LAN networks. Security topics include confidentiality/privacy, integrity, availability, and control of fraudulent usage of networks. Issues addressed include jamming, interception and means to avoid them. Case studies and student projects are an important component of the course.
2. Familiarize students with the issues and technologies involved in designing a wireless system that is robust against attack.
3. Understand the various ways in which wireless networks can be attacked and tradeoffs in protecting networks.
4. Understand of underlying system applications and potential security issues early in the design process.

Course Outcomes
On completion of this course the student will be able to:

1. Address wireless security issues and Economic tradeoffs. (a,b)
2. Describe various wireless systems -1G,2G, Spread Spectrum, CDMA,TDMA,GSM,3G and 4G. (a,c)
3. Analyze Air-ground-interface and vulnerabilities. (a,d)
4. Apply digital cryptography in wireless transmission. (a,f)
5. List the Limits of Encryption Block and stream Ciphers. (a,k)

6. Describe various wireless security protocols. (a,c)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 310	**CO1**	1	1										**1**	**1**	
	CO2	1		2									**2**	1	
	CO3	2			**2**								**2**	2	**1**
	CO4	2					**3**						**2**	1	**1**
	CO5	2										**3**	**2**		**3**
	CO6	2		2									**2**	2	**1**

Course Contents:

UNIT 1:Wireless Threats [14]

Introduction: Protecting the Means of Communication, Protecting Privacy, Promoting Safety, Understanding Wireless Forecasts, and Reasonable Degrees of Security. Security issues and Economic tradeoffs. Cellular Networks and Bearer Technologies. Four Generations of Wireless systems: 1G,2G, Spread Spectrum, CDMA,TDMA,GSM,3G and 4G.

UNIT 2:Air-ground-interface and vulnerabilities [14]

Telephone System Vulnerabilities, unintentional Interruptions, Cell Phone Vulnerabilities, Issue of Privacy, Satellite Communications: Global Positioning System, Wide Area Augmentation System, Satellite Search and Rescue, Communications: Voice, Video, and Data. Satellite Internet, Earth Sensing: Commercial Imaging, Landsat, SPOT, European Remote Sensing, IKONOS. Computer crime, Security of Information Systems, Balancing Information Technology Information Vulnerability, Importance of Information.

UNIT 3:Cryptographic Counter measures [14]

Lock-and-Key Analogy, Classical Cryptanalysis, Digital Cryptography, Brute Force Attacks, Standard Attacks, Advanced Attacks, Two Limits of Encryption Block versus stream Ciphers. The Stream Cipher Synchronization Problem, Non-Keyed Message Digests, SHA-1 in the Encryption Mode, HORNET, Entropy Accumulator Description, Sync, pad, and Data Encryption Key Advanced Encryption Standard, Key Management-Generation and Distribution of Keys.

UNIT 4:Wireless Security protocols [14]

The Wireless Local Area Network (WLAN). Wireless Application Protocol (WAP), Wireless Transport Layer Security Bluetooth. Recent trends in the related areas from journals, Conference proceedings, Book chapters.

Reference books:

1. Nichols and Lekkas "**Wireless Security – Models, Threats, and Solutions**," by, McGraw-Hill, 2002.

2. Jon Edney and William A. Arbaugh. “**Real 802.11 Security: Wi-Fi Protected Access and 802.11i**”, Addison-Wesley Professional, 2003.
3. Andrew Vladimirov, Konstantin V. Gavrilenko, and Andrei A. Mikhailovsky. “**Wi-Foo: The Secrets of Wireless Hacking”,** Addison-Wesley Professional, 2004.
4. Johnny Cache and Vincent Liu “**Hacking Exposed Wireless**’’, McGraw Hill Companies, 2007.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2320	**Application Development**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of coding using object oriented languages

Course Objectives:

1. Understand and Create, refine, or strengthen mobile development strategy.
2. Study the key concepts needed to develop mobile apps and mobile websites, using a variety of platforms and technologies.
3. Know how to develop an iOS app, Basics of the Android SDK, Develop a BlackBerry Java app, Develop a BlackBerry Web Works app, Windows Phone 7 development, Basic Java Script development and creating an app with Phone Gap.
4. Study debugging iOS Apps.
5. Know how to create consumable web services

Course Outcomes

On completion of the course the student will be able to

1. Demonstrate the technical challenges posed by current mobile devices and wireless communications. (a,b)
2. Analyze and be able to evaluate and select appropriate solutions. (a,c,d)
3. Demonstrate and appreciate the need to keep up with rapid changes and new developments; be able to identify current trends in mobile communications technologies and systems. (a,b)
4. Select and evaluate suitable software tools and APIs for the development of a particular mobile application and understand their strengths, scope and limitations. (a,i)
5. Implement mobile user interface designs.(a,d,f)
6. Demonstrate an appropriate application development to design, write and test small interactive programs for mobile devices. (a, b)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 320	**CO1**	1	1										**1**		**1**
	CO2	1		2	2								**2**	1	
	CO3	1	2											2	**1**
	CO4	2								3			**1**	3	
	CO5	2			**2**		**3**					**3**	**2**	1	**3**
	CO6	2	2										**1**	2	

Course Contents:

UNIT 1: Introduction **[14]**

Preliminary Considerations; Diving into Mobile: App or Website? - Mobile Web Presence, Mobile Applications, Your App as a Mobile Web App.

UNIT 2: Creating Consumable Web Services for Mobile Devices **[14]**

What Is a Web Service? Web Services Languages (Formats), Creating an Example Web Service, Debugging Web Services.

UNIT 3: Mobile User Interface Design **[14]**

Effective Use of Screen Real Estate, Understanding Mobile Application Users, Understanding Mobile Information Design, Understanding Mobile Platforms, Using the Tools of Mobile Interface Design; Mobile Websites: Choosing a Mobile Web Option, Adaptive Mobile Websites, Dedicated Mobile Websites, and Mobile Web Apps with HTML5.

UNIT 4: ANDROID **[14]**

Android as Competition to Itself, Getting the Tools You Need, Connecting to the Google Play, Android Development Practices, Building the Derby App in Android; Getting Started with IOS: The iPhone Craze, Getting the Tools You Need, iOS Project, Debugging iOS Apps, Objective-C Basics, Hello World App, Building the Derby App in iOS.

Reference books:

1. Jeff McWherter and Scott Gowell, "**Professional Mobile Application Development**", John Wiley & Sons, Inc., 2012
2. Lauren Darcey and Shane Conder "**Sams Teach Yourself Android Application Development in 24 Hours**", Second Edition, SAMS, 2012
3. Adrian Kosmaczewski, "**Mobile JavaScript Application Development**", O'Reilly Media, Inc., 2012

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2330	**Optical Communication and Networking**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Perquisites

Basics for Noise, communication, fundamentals data communication and Networking.

Course Objectives:

1. To Understand signal propagation in fibre with losses.
2. To know the different devices and components used for optical communication.
3. To introduce concepts of transmission system in optical fiber.
4. To understand the optical network concepts
5. To Present RTOS tools and case studies

Course Outcomes:

On completion of this course the students will be able to:

1. Understand the basics and importance of real-time systems.
2. Generate a high-level analysis document based on requirements specifications.
3. Generate a high-level design document based on analysis documentation.
4. Generate a test plan based on requirements specification.
5. Generate a validation plan based on all documentation.
6. Understand basic multi-task scheduling algorithms for periodic, aperiodic, and sporadic tasks as wellas understand the impact of the latter two on scheduling
7. Understand capabilities of at least one commercial off-the-shelf R-T kernel
8. Participate in a team design project, utilizing varying skill sets of members.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2330	**CO1**	1		1									**1**	**2**	
	CO2	2	3	2									**2**	1	
	CO3	1	2	3									**1**	2	
	CO4	1	3	3									**2**	2	
	CO5	2	2	3								**3**	**2**	1	**3**
	CO6	1		2									**2**	1	
	CO7	1		2									**2**	1	
	CO8	1	2	2	**3**	**3**							**2**	2	**3**

Course Contents:

Unit 1: Introduction **[14]**

Propagation of signals in optical fiber: Ray theory transmission, Electromagnetic mode theory for optical propagation, Transmission characteristics of optical fiber - Attenuation ,Dispersion, Modal Dispersion, Chromatic Dispersion, Polarization mode dispersion, Dispersion modified single mode fibers - Dispersion Shifted fibers, Dispersion flattened fiber

Unit 2: Modulation and Demodulation **[14]**

Transmitters - LED, Lasers, Tunable Lasers, Receiver- Photo detector, Front end amplifiers, Noise considerations, Ideal receiver, Practical Direct Detection Receiver , Bit Error rates , Optical SNR, power penalty ,Quantum limit of Detection.

Unit 3: Optical Networks **[14]**

Introduction to Optical Components – Couplers, Isolators, Circulators, Multiplexers, Bragg Grating, Filters, Digital Multiplexing Hierarchy and Signaling Hierarchies, Layered Protocol Model in the Transport Network, Timing and Synchronization, SONET and SDH, Architecture of Optical Transport Networks (OTNs)

Unit 4: Network Configurations **[14]**

Network Topologies and Protection schemes – Types of Topologies, BLSR, Protection switching on 4-fiber BLSR, Passive Optical Networks, WDM, DWDM, TDM vs. WDM, Add drop Multiplexers, WDM Amplifiers, WDM cross connects, ATM vs. IP in optical Networks, Case study – Test and Measurement of Optical Networks.

Text Books

1. John M. Senior, **"Optical fiber communication",** Pearson edition, 2000.
2. Uyless Black **"Optical Networks ",** Pearson Education , 2011.

Reference books:

1. Rajiv Ramswami and K. N. Sivarajan, **"Optical Networks",** Morgon Kauffman Publishers, 2008.
2. Gerd Kaiser, **"Optical fiber Communication Systems",** John Wiley, New York, 2009.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2410	**RF and Microwave Circuits**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Fundamentals of Electromagnetism, Microwave theory, RF Transmission lines

Course Objectives:

1. To provide a comprehensive introduction RF circuits and their applications in communication systems
2. To study the theoretical and practical aspects of microwave devices as applied to communication system
3. To understand the theory behind antennas design
4. To Learn some examples of design of microwave components , devices and antennas using suitable simulation software

Course Outcomes

On completion of this course the student will be able to:

1. Differentiate the characteristics of constant k type and m-derived microwave filters. (a,b,c)
2. Design a microwave oscillator and amplifier. (a,b,d)
3. Describe the operation of coupled filters. (a,b)
4. Characterize the SNR performance of a microwave receiver. (a,b,f)
5. Given a loaded Q, given practical inductor and capacitors, design a suitable resonant circuit.(a,b)
6. Given the source and load resistances or reactance, design a suitable matching circuit. (a,d,f)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 410	**CO1**	1	1	2									**1**		**1**
	CO2	1	2		2								**2**	1	
	CO3	1	2											2	**1**
	CO4	2	2				**3**						**2**	3	
	CO5	2	3									**3**	**2**	1	
	CO6	2			**2**		**3**						**2**	2	**1**

Course Contents:

UNIT 1: Basics of RF and Microwave **[14]**

Introduction to RF, applications of RF and microwave, introduction to component basics, analysis of simple circuits in phasor domain: loaded Q, impedance transformation, insertion loss, RF impedance matching, transmission media, S-parameters and generalized S-parameters, basic signal flow graphs.

UNIT 2: Smith chart and RF filter design **[14]**

Introduction to Smith chart, impedance matching using lumped elements with smith chart, impedance matching using distributed components with smith chart, constant k and m-derived filters, basics of coupled line filters, filters using coupled resonators. Impedance matching using CAD software's or freeware's

UNIT 3: Microwave Amplifiers and Oscillators **[14]**

Characteristics of microwave transistors, Gain and stability, single stage amplifier design: design for maximum gain, design for specific gain, low noise amplifier design, broadband amplifier design, oscillator design: One port negative resistance oscillator design, transistor oscillators, dielectric resonator oscillators, Amplifier design using CAD software's

UNIT 4: Active microwave circuits and MMIC **[14]**

Noise in microwave circuits, Noise characterization of a microwave receiver, Detectors and mixers, Spectrum analyzer basics, PIN diode control circuits: PIN diode phase shifters, Microwave integrated circuits: hybrid microwave integrated circuits, monolithic microwave integrated circuits, overview of microwave sources: solid state devices and microwave tubes. Recent trends in the related areas from journals, Conference proceedings Book chapters

Reference books:

1. Reinhold Ludwig and Pavel Bretchko, ''**RF Circuit Design, Theory and Applications**'', Pearson Asia Education, Edition 2001.
2. Samuel Y. Liao, "**Microwave Devices and Circuits**", Pearson education, 3rd edition 2003.
3. R.E.Collin, "**Foundations for Microwave Engineering**", Tata McGraw Hill, 2nd Edition 1992.
4. David M. Pozar, "**Microwave Engineering**", John Wiley & Sons, New York, 1998.
5. Mathew M. Radmanesh, "**Radio Frequency and Microwave Electronics**", Pearson Asia Education, 2001.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2420	**Linux Kernel Programming**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites

Knowledge of basics of LINUX operating system and Kernel

Course Objectives:

1. Understand the essentials of Linux device drivers.
2. Know practical experience in developing Linux device drivers.
3. Study and Explain extensibility features of Linux kernel for device driver development
4. Know customized extensions for embedded application using Linux kernel
5. Understand and develop device drivers for character devices, block devices and network devices.

Course Outcomes

On completion of this course the students will be able to:

1. Design and describe the embedded Linux Kernel, Device Driver and Device Driver Modules. (a,d)

2. Analyze and evaluate Android architecture and Android Runtime-Instances of Dalvik, services, Dalvik virtual machine and Zygote. (a,b,c)
3. Implement an Android and port it to an embedded device, and to configure the Linux kernel and drivers to support Android. (a,b,d)
4. Innovate design, analysis and Implementation to hardware interfacing of embedded systems for Linux or Android platforms will be discussed. (a,c,d)
5. Implement race condition and concurrent programming. (a,b)

Mapping of Course Outcomes with Program Outcomes

Course Code	**POS/ COs**	**PO 1**	**P2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**P7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PS O1**	**PS O2**	**PS O3**
MTDC16F2 420	**CO1**	2			**3**								**2**	**2**	
	CO2	2	2	3									**2**	3	
	CO3	3	2		**3**								**3**	2	**1**
	CO4	2		2	**3**								**2**	1	**3**
	CO5	2	3										**2**	3	

Course Contents:

UNIT 1: LINUX-Operating Systems **[14]**

Main Characteristics, Introduction to Kernel-Important Data Structures-Main Algorithms. Implementing System Calls-Compiling the KERNEL (Practical is Possible)Kernel Related Command and the boot process-RHG “proc” file System.

UNIT 2: Device Driver **[14]**

LINUX-Characteristics and Block Devices-Polling and Interrupt-The Hardware-Implementing a Driver

UNIT 3: Inter Process Communication **[14]**

Synchronization in the Kernel-Communication Via files-Pipes-Debugging using “D trace”-System V 1pc-1 PC with SOCKETS

UNIT 4: Memory Management **[14]**

Architecture Indepen0dent memory model in LINUX-Virtual Address Space for a Process-Block Device Coaching-paging under LINUX-Introduction to process and threads and related topics.

Programming Assignment:

1. Cross development environment creation for specific target (Eg. ARM9).
2. Building and compiling Linux kernel module
3. Refreshing process management, file system and memory management concepts through practices.
4. Race condition and concurrent programming
5. Writing device driver in Linux for CMOS device on PC
6. UART/USB/TTY/PCI device driver development

7. Ethernet device driver modification.

Reference Books:

1. Michael Bech, HaraldBohrre, MirkoDziadzka, Ulrich Kunitz,“**Linux Kernel Internals**” Addison Wesley Publisher. 3rd Edition , 1998
2. Alessandro Rubini And Jonathan Corbet “**Linux Device Drivers**”, O’reilly Publishing 2007
3. KarimYaghmour, “**Building Embedded Linux Systems**” O'Reilly Publishing 2005
4. Gary Nutt, “**Kernel Projects-For Linux**” Addison Wesley Publications. 2004

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2430	**Wireless Network Standards**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:
Basics of wireless networks and protocols

Course Objectives:

1. To understand government regulations, standardization bodies, link budgets, the design of a wireless communication standard and principles of spread-spectrum communications.
2. To understand IEEE 802.11 networks, Architecture of 802.11, the 802.11 MAC protocol, the different physical layers of 802.11, the Security and Quos protocols used in 802.11, and the throughput of 802.11.
3. To study IEEE 802.15.1 (Bluetooth)networks and architecture, the recommended practice for coexistence between 802.11b and 802.15.1, the IEEE 802.15.3 standard for high data rate wireless personal area network, and the 802.15.4 standard for low data rate wireless personal area network.
4. To know IEEE 802.16 network and protocol architecture, the 802.16 MAC protocol, the different physical layers of 802.16 and interference problems in 802.16.

Course Outcomes

On completion of this course the student will be able to:

1. Present Government regulation regulatory changes, Future FCC of Wireless network standards. (a,b)
2. Describe IEEE 802.11, IEEE 802.11a, IEEE 802.11g standards (a,b,d)
3. Compare WPAN and WLAN. (a,b,j)
4. Explain Overview and architecture, PHY layer, of 802.15.4 MAC.(b,d)
5. Explain Air Interference for fixed Broadband Wireless Access Systems MAC enhancement for OFDM and OFDMA PHYs, IEEE 802.16 Physical layers (a,b)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 430	**CO1**	1	2										**1**	**2**	
	CO2	1	2		3								**2**	2	
	CO3	1	1								**2**		**1**	2	
	CO4		2	3									**2**	3	**1**
	CO5	2	3										**2**		**2**

Course Contents:

UNIT 1: **Overview** **[14]**

Government regulations, Recent regulatory changes, Future FCC directions, Standardization bodies, Wireless channels, Design of a wireless communication standards , MAC requirements, PHY requirements, sub layers of PHY and MAC.

UNIT 2: **The IEEE standard for WLAN** **[14]**

IEEE 802.11Inter access point protocol(IAPP), Medium access mechanism and real time traffic over, IEEE 802.11, Enhancement in IEEE 802.11e, Power saving mechanism, IEEE 802.11 physical layers, DSSS PHY, IEEE 802.11b, IEEE 802.11a, IEEE 802.11g, WLAN installation, IEEE 802.11 technology and business trends.

UNIT 3: Standards for Wireless Personal Area Networking (WPAN) **[14]**

Introduction, comparing WPAN and WLAN, IEEE 802.15.1 Physical layer, Baseband, LMP and L2CAP, Coexistence among wireless standards, collaborative methods, Non collaborative methods, Chanel classification, PHY and MAC models, High rate WPAN, MAC layer, Physical layer for the 2.4 GHZ ISM Band, Low rate WPAN, Overview and architecture, PHY layer, 802.15.4 MAC, Coexistence issues involving IEEE 802.15.4, WPAN technology and business trends.

UNIT 4: **Air Interference for fixed Broadband Wireless Access Systems** **[14]**

MAC convergence sub layer, MAC common part sub layer, Network entry and initialization, channel access and QoS, MAC enhancement for 2-11 GHZ Operation, MAC enhancement for mesh systems, Advanced antenna systems, automatic repeat request(ARQ), DFS for license exempt operation, MAC enhancement for OFDM and OFDMA PHYs, IEEE 802.16 Physical layers, physical layer for 10-66 GHZ, physical layers for 2-11 GHZ operation, Coexistence, BWA business and technology trends. Recent trends in the related areas from journals, Conference proceedings, Book chapters.

Reference Books:

1. TodorCooklev, “**Wireless Communication Standards**”, IEEE Standards Association, 2004

2. Rappaport, “**Wireless Communications Principles and Practices**”, Prentice-Hall, 2nd Edition, 2002.
3. http://standards.ieee.org.

Course Code	Course Title	Duration		L	T	P	C
MTDC15F2440	**DSP Algorithms for Communication Engg.**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:
Basics of Signals and system, digital signal processing.

Course Objectives:

1. To understand Signals and Systems, Frequency domain analysis of a digital filter, Elementary Operations
2. To understand Multistage implementation of digital filters ,Multirate Systems and Signal Processing
3. To study DFT filter banks,Transmultiplexers. Application of transmultiplexers in communication systems.
4. To know various transforms such as Gabor, wavelet etc. for frequency expansion.

Course Outcomes
On completion of this course the student will be able to:

1. Signals and Systems, Frequency domain analysis of a digital filter, Elementary Operations. (a,b, d)
2. Describe Multistage implementation of digital filters ,Multirate Systems and Signal Processing (b,d)
3. Explain Overview of DFT filter banks,Transmultiplexers. Application of transmultiplexers in communication systems. (b,d)
4. Explain Applications of Maximally Decimated filter banks,frequency expansion algorithms. (a,b)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC15F2 440	**CO1**	2	1		**2**								**1**	**2**	
	CO2		1		2								**2**	1	1
	CO3		2		**1**								**1**	2	
	CO4	2	2										**2**	3	**1**

Course Contents:

UNIT 1: **Review of Signals and Systems** **[14]**

Discrete time processing of continuous signals - Structure of a digital filter; Frequency domain analysis of a digital filter; Quantization error; Sigma and Sigma Delta Modulation. Fourier analysis – DFT, DTFT, DFT as an estimate of the DTFT for Spectral estimation. DFT for convolution, DFT/DCT for compression, FFT. Ideal Vs non ideal filters, FIR and IIR Filters Digital Filter Implementation; Elementary Operations

UNIT 2: **Multirate Systems and Signal Processing** **[14]**

Problems and definitions; Up sampling and down sampling; Sampling rate conversion by a rational factor; Multistage implementation of digital filters**;** Efficient implementation of multirate systems.

UNIT 3: Filter Banks **[14]**

DFT filter banks and Transmultiplexers:DFT filter banks, Maximally Decimated DFT filter banks and in communications Modulation.

Maximally Decimated Filter banks – Vector spaces, Two Channel Perfect Reconstruction conditions; Design of PR filters Lattice Implementations of Orthonormal Filter Banks, Applications of Maximally Decimated filter banks to an audio signal.

UNIT 4: **Introduction to Time Frequency Expansion** **[14]**

The STFT; The Gabor Transform, The Wavelet Transform; The Wavelet transform; Recursive Multiresolution Decomposition.

Reference books:

1. Roberto Cristi, "**Modern Digital Signal Processing**", Cengage Publishers, India, (erstwhile Thompson Publications), 2003.
2. S.K. Mitra, "**Digital Signal Processing: A Computer Based Approach"**, III Ed, Tata McGraw Hill, India, 2007.
3. E.C. Ifeachor and B W Jarvis, "**Digital Signal Processing, a practitioners approach**," II Edition, Pearson Education, India, 2002 Reprint.
4. Proakis and Manolakis, "**Digital Signal Processing**", Prentice Hall 1996 (third edition).

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2510	**Digital Audio and Video broadcasting**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of computer networks. Network protocol, Probability and Random Process

Course Objective:

1. To understand the benefits of simulation and modeling in a range of important application areas.
2. To study simulation software to understand event –scheduling, Time-advance algorithm
3. In computer networks.
4. To study the Essentials of Probability and Random Process
5. To understand Discrete Event Stochastic Models and Queuing Models
6. To learn the concepts of simulation for the various layers.

Course Outcomes

On completion of this course the student will be able to:

1. Analyze the concepts of simulation for systems(a,b,d)
2. Describe the role of important elements of simulation and modeling paradigm. (b,d)
3. Apply the mathematical techniques to model and analyze structural and dynamical properties of Discrete-Event systems. (b,d)
4. Describe Output analysis for discrete-event simulation algorithms. (a,b)
5. Implement and apply simulation on various layers for Optimization(a,b,d)
6. Present the Modeling techniques for event systems.(a,c,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 510	**CO1**	2	2		**3**								**2**	**2**	**3**
	CO2		1		2								**1**	2	
	CO3		2		**3**									1	**2**
	CO4	2	1										**1**	2	
	CO5	2	2		**3**								**2**		**3**
	CO6	1		2	**1**								**1**		**2**

Course Contents:

UNIT 1:Introduction of Digital Multimedia **[14]**

Introduction. Speech Production Model, Organ pipe model and formant frequencies. Speech coding: Channel vocoder. Objectives and Requirements, Quantizers for speech signal, Mew – law and Optimum Quantizer for speech signal

UNIT 2: Audio-Speech/Sound Encoding **[14]**

Adaptive Quantizer, Differential Quantization, LDM and ADM, Differential PCM and Adaptive Prediction, Linear Prediction of Speech.

UNIT 3 : Image coding **[14]**

Introduction to Image and Video Coding, Lossy Image Compression(DCT), DCT Quantization and Limitations.

UNIT 4: **Video coding** **[14]**

Video Coding: Basic Building Blocks, Motion Estimation Techniques, Fast Motion Estimation Techniques, Video Coding Standards.

Case Study: Find the PSNR and mean square error for a given image using JPEG algorithm.

Reference Books:

1. Aamitarh Kumar, "**Mobile Tv-Dvb-H, Dmb, 3g Systems of Rich Multimedia Applications**" Elseiver, Foeac Press. 2008
2. Hervé Benoit"**Digital Television**" Taylor & Francis, 2008
3. Mark Massel, "**Digital Television: DVB-T, COFDM and ATSC 8-VSB**", Lulu Press, Inc., 2013

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2520	**Consumer and Entertainment Electronics**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisite

Digital Signal processing, Communication Systems, Audio Video Broadcasting systems, Computer Organization and Operating systems, Analog and digital design, Communication and networking, Reliability Engineering

Course Objectives

1. To provide an understanding of the product design targeting specific Industrial segment
2. To provide and understanding of the care and concerns of the user and suitably provide the protections without compromising cost and quality.
3. To have an understanding of the various subjects and its relevance to a specific Product segment.
4. To provide a comprehensive look at the challenges in Engineering problems to provide an effective and efficient solution

Course Outcomes:

1. To determine variousalternatives of the design and arrive at the best by taking into concern the constraints of the user / buyer. (a,b,c)
2. Determine Verification and validation process of the product by taking the requirements and specification needed. (a,b,d)
3. Apply the principles and practices that were studied appropriately to product being planned. (a,b)
4. To determine packaging concerns to protect against the environmental factors. (a,b)
5. To determine the configuration and arrive at a range of product with varying degrees of cost, specification and requirements. (a,b,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 520	**CO1**	1	2	2									**2**	**1**	
	CO2	2	2		3								**2**	2	
	CO3	2	3										**3**		**1**
	CO4	2	2										**2**	1	**2**
	CO5	2	2		**2**								**2**	2	**3**

UNIT 1: Systems Thinking [14]

Systems approach to solutions Engineering – System definition – System Boundary – System inputs and outputs – System operating environment – Environment variables – Constraints – Functional and Nonfunctional Requirements - Systems architecture – System Functionality – HW / SW and HuW partitioning. Systems reliability and quality – System Development Life cycle model – Spiral modeling.

UNIT 2:Basic concepts of embedded solutions [14]

System analysis and hard real time and soft real time task analysis – Computing systems – CPU Board and OS -Scheduling concepts – One case study – Performance analysis and meeting the requirements – Power / Response time – Optimization.

UNIT 3:Considerations for product Design [14]

A typical Entertainment system and consumer applications – Typical Examples could be SET TOP BOX, and Voice over IP Telephone system, Multimedia Hand held terminals, Wearable Devices - Holistic Product Development analysis.

UNIT 4:Nonfunctional requirements [14]

Reliability, MTTF and MTTR, UP Time and Down time analysis of the product of choice – Consumer Goods Standards and relevant specifications- Product Verification and validation processes.

Text Book:

1. Bali S.P , "**Consumer Electronics**", Pearson Education, 2007
2. Fred Halsall, "**Multimedia Communications: Applications, Networks, Protocols and Standards**", Addison-Wesley, 2001.
3. Ze-Nian Li and Mark S. Drew, "**Fundamentals of Multimedia**", Pearson Prentice Hall, October 2003
4. IEEE Transaction on Consumer Electronics – Various volumes.

Course Code	Course Title	Duration		L	T	P	C
MTDC16F2530	**Network Programming**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

UNIX basics operating systems wireless networks and protocols

Course Objectives:

1. To understand the fundamentals of networks and network programming.
2. Learn different approaches to the design of a network application, protocol and advanced application design.
3. Learn practical approach: by learning various methods of securing a network application, programming with the Open SSL toolkit, and authentication.

Course Outcomes

On completion of this course the student will be able to:

1. Present fundamentals of networks and network programming. (a,b)
2. Code the socket programming for file Transfer and Error Handling. (a,c,d)
3. Explain different approaches to the design of a network application, protocol and advanced application design. (a,b,c)
4. Analyze Server Architecture for Multiplexing, Forking, and Multithreading operations (a,b,d)
5. Present Case Study of Networked Application and Secure Networked Application. (a,b)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F2 530	**CO1**	1	2										**2**	**1**	
	CO2	2		2	1								**2**	2	
	CO3	1	2	1									**1**	2	
	CO4	2	2		**3**								**2**	2	**1**
	CO5	2	3										**2**		**3**

Course Contents:

UNIT 1: Networks and Protocols **[14]**

Circuits vs. Packets, Internetworking, Ethernets, Ethernet Frames, Addressing, Internet Protocol, User Datagram Protocol, Transmission Control Protocol, The Client-Server Model, The Domain Name System, State vs. Stateless, Methods for Maintaining State; **Socket Programming:** What Is a Socket, Using Sockets, User Datagram Protocol, File Transfer, Error Handling

UNIT 2: Client-Server Architecture **[14]**

Client Test Program, Multiplexing, Forking, Multithreading, Combining Preforking and Prethreading, Method Choosing, Dealing with Large Amounts of Data, Debugging and Development Cycle; **Custom Protocol Implementation:** Designing a Custom Protocol, Our Chat Protocol, Protocol Registration, TCP vs. UDP, Application Protocol Choices, Client-Server Architecture, Client-Side Considerations, Server-Side Considerations

UNIT 3: Securing Network Communication **[14]**

Tunneling, Public Key Infrastructure, Secure Network Programming Using OpenSSL, The Old Scenario, The Present-Day Scenario, The PAM Library, Public Key Authentication, Single Sign-on, Common Attacks, Buffer Overflow, Secure Coding, Tools of the Trade

UNIT 4: Case Study **[14]**

A Networked Application, a Secure Networked Application. Recent trends in the related areas from journals, Conference proceedings, Book chapters.

Reference books:

1. Keir Davis, John Turner and Nathan Yocom, "**The Definitive Guide to Linux Network Programming**'', Apress, 2004.
2. Warren Gay, "**Linux Socket Programming by Example**", Que, 2000.
3. Graham Glass and King Abls, "**UNIX for Programmers and Users**", Pearson Education, 3rd edition, 1998.
4. M. J. Rochkind, "**Advanced UNIX Programming**", Pearson Education, 2nd edition, 2004.

Semester III

Course Code	Course Title	Duration		L	T	P	C
MTDC16F3110	Internet of Things- Practical Approach	16 Weeks	SC	4	1	0	5

Prerequisites:

Basics of wireless networks, protocols, sensors

Course Objectives:

1. To study the full connected-product experiences by integrating Internet services and physical objects
2. To know developing prototypes of Internet-connected products using appropriate tools
3. To understand Basic Arduino programming. Extended Arduino libraries. Arduino-based Internet communication
4. To study XML and JSON. HTTP APIs for accessing popular Internet services

Course Outcomes

On completion of this course the student will be able to:

1. Understand full connected-product experiences by integrating Internet services and physical objects (a,b)
2. Analyzing, designing, and developing prototypes of Internet-connected products using appropriate tools. (a,b,c,d)
3. Identifying, classifying and describing different kinds of Internet-connected product concepts Describe different network protocols (a,c,d)
4. Analyzing the challenges and applying adequate patterns for user-interaction with connected-objects. (a,b,c,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F3 110	CO1	1	2										**2**	**1**	
	CO2	2	2	3	3								**2**	2	3
	CO3	1		2	**2**								**2**		**2**
	CO4	2	3	2	**3**								**2**	3	**3**

Unit 1: Introduction to Internet of Things **[14]**

Introduction , Wireless sensor networks, Applications, Roles in WSN .

Unit 2: Design principle for connected objects **[14]**

Calm and Ambient technology, Magic as Metaphor ,Privacy :Keeping Secrets ,Whose Data Is It

Anyway?;Web Thinking for Connected Devices ,Small Pieces, Loosely Joined ,First-Class Citizens On The Internet Graceful Degradation ,Affordances.

Unit 3: Prototyping of connected objects [14]

Prototyping Embedded Devices: Electronics :Sensors ,Actuators ,Scaling Up the Electronics ;Embedded Computing Basics: Microcontrollers, System on-Chips ,Choosing Your Platform ;Arduino: Developing on the Arduino ,Some Notes on the Hardware Openness ; Other Notable Platforms Mobile Phones and Tablets Plug Computing: Always-on Internet of Thing. **Prototyping Online Components:** Getting Started with an API :Mashing Up APIs ,Scraping ,Legalities, Writing a New API :Clockodillo ,Security ,Implementing the API ,Using Curl to Test, Going Further ;Real-Time Reactions :Polling ,Comet ;Other Protocols: MQ Telemetry Transport ,Extensible Messaging and Presence Protocol ,Constrained Application Protocol.

Unit 4: Internet Communications [14]

Internet Communications: An Overview ,IP ,TCP ,The IP Protocol Suite (TCP/IP) ,UDP ;IP Addresses :DNS ,Static IP Address Assignment ,Dynamic IP Address Assignment ,IPv6 ,MAC Addresses ;TCP and UDP Ports :An Example: HTTP Ports ,Other Common Ports ;Application Layer Protocols :HTTP , HTTPS: Encrypted HTTP ;Other Application Layer Protocols

Reference books:

1. IoT in 5 days Antonio Liñán Colina, Alvaro Vives, Antoine Bagula, Marco Zennaro and Ermanno Pietrosemoli Revision 1.0 March 2015.
2. Designing the Internet of Things by Adrian McEwen &Hakim Cassimaly.2014
3. Getting Started with Arduino (Make: Projects). Massimo Banzi. O'Reilly Media. 2008

Course Code	Course Title	Duration		L	T	P	C
MTDC16F3120	**Communication system design using FPGA**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of designing a digital system, FPGA architecture, design using FPGA.

Course Objectives:

1. Understand Digital system design using HDL.
2. Know FPGA architecture, interconnect and technologies.
3. Know different FPGA implementation methodologies.
4. Understand configuring and implementing digital embedded system, microcontrollers, microprocessors, DSP algorithm on FPGA.

Course Outcomes

On completion of the course the students will be able to:

1. Design reconfigurable digital systems. (a,b,d)

2. Demonstrate and Debug the embedded systems before the actual product is developed (a,b)
3. Design finite state machines for various applications (a,d)
4. Design dynamic architectures using FPGA's. (a,c,d)
5. Implement, Design and develop embedded system using EDA tools (a,c,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F3 120	**CO1**	2	2		**3**								**2**	**1**	
	CO2	2	3										**2**	2	
	CO3	2			**3**								**1**	2	
	CO4	2		2	**3**								**2**		**3**
	CO5	2		2	**3**								**3**		**2**

Unit 1: Digital modem techniques of FPGA **[14]**

QPSK, QAM-16, 64, 256 digital modulation on FPGA, channel modeling-AWGN channel, multipath Rayleigh fading , QPSK,QAM demodulation ,Performance evaluation of digital modulation schemes based on channel parameters.

Unit 2: Digital modem **[14]**

OFDM, CDMA, FHSS, SS, DSS implementation on FPGA

Unit 3: Software radios **[14]**

Introduction to reconfigurable radio, Software Defined Radio Architecture. Digital Signal Processor and SDR Baseband Architecture. Reconfigurable Wireless communication Systems. Digital Radio Processing. Implementation of SDR internal block on FPGA

Unit 4: Cognitive radios **[14]**

Introduction to cognitive Radio, Spectrum sensing Methods, Implementation of spectrum sensing methods on FPGA

Reference Books:

1. M.J.S. Smith, **"Application Specific Integrated Circuits**'', Pearson, 2000
2. Peter Ashenden, "**Digital Design using VHDL**'', Elsevier, 2007
3. Peter Ashenden, "**Digital Design using Verilog**'', Elsevier, 2007
4. W.Wolf, "**FPGA based system design**'', Pearson, 2004
5. Clive Maxfield, "**The Design Warriors's Guide to FPGAs**'', Elsevier, 2004

Course Code	Course Title	Duration		L	T	P	C
MTDC16F3130	**Wireless Testing and Automation**	**16 Weeks**	**SC**	**4**	**1**	**0**	**5**

Prerequisites:

Knowledge of different wireless technologies, software testing.

Course Objectives:

1. To provide introduction about different wireless technologies like GSM GPRS,EDGE UMTS
2. To study the development of TTCN-3,
3. To understand TTCN in detail for software testing.
4. To know the case study Procedure-Based Communication in TTCN-3,

Course Outcomes

On completion of this course the student will be able to:

1. Describe about different wireless technologies and wireless automation using open source software testing tool. (a,b)
2. Implement test execution by describe relations between test cases such as sequences, repetitions and dependencies on test outcomes (a,b,d)
3. Present the concurrent test configurations with dynamically created test components and communication topologies to the system under test (a,c)
4. Analyze the data and behavior by message-based and signature-based interfaces (a,b,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F3 130	CO1	2	1										**1**	**2**	
	CO2	2		2	3								**2**	1	
	CO3	1		2									**1**		**2**
	CO4	1	2		**3**								**2**	3	

Course Contents:

UNIT 1: Wireless Technologies **[10]**

Introduction to wireless communication systems, Modern wireless technologies: GSM, GPRS, EDGE, UMTS, and Wireless Application Protocol. Introduction to mobile wireless test automation.

UNIT 2: TTCN-3 **[10]**

TTCN-3 as a Language, the Development of TTCN-3,2 TTCN-3 by Example, TTCN-3 Test Suite, TTCN-3 Test Systems, Basic TTCN-3. Basic Constructs, Basic Statements.

UNIT 3: Single and Multi Component TTCN-3 **[10]**

Single Component TTCN-3 Ports, Components, Test Cases, Templates, Message-Based Communication, Timers, Alt Statement, Altsteps, Default Altsteps, Functions.

Multi Component TTCN-3 Multi Component Test Case Example, Test Components, Mappings and Connections, Component Type Extension, Miscellaneous Port Operations, SUT Addresses, Putting the Pieces Together

UNIT 4:Procedure-Based Communication **[10]**

Procedure- versus Message-Based Communication, An Example – the Directory Service, Procedure-Based Communication in TTCN-3, Communication Operations, Procedure-Based Communication on the Client Side, Procedure-Based Communication on the Server Side, Addressing. Recent trends in the related areas from journals, Conference proceedings, Book chapters.

Reference books:

1. Theodore S. Rappaport, "**Wireless Communications: Principles and Practice**",Prentice Hall, 2nd Edition, 2002.
2. Colin Willcock, Thomas Deib, Stephan Tobies, Stefan Keil, Federico Engler, Stephan Schulz and Anthony Wiles "**An Introduction to TTCN-3**", Wiley, 2nd Edition, 2011.
3. https://sites.google.com/site/mobilewirelesstestautomation/resources - for mobile test automation

Course Code	Course Title	Duration		L	T	P	C
MTDC16F3200	**Automotive Electronics System**	**16 Weeks**	**OE**	**4**	**0**	**0**	**4**

Course Objectives:

1. Understand the functions of electronic systems in modern automobiles, modern electronics technology to improve the performance, safety, comfort and related issues
2. Study the principles of automotive sensors and interfacing techniques, design, model and simulate interfacing systems with sensors
3. Know the principles and functionalities of various Automotive Communication Protocols (ACPs), Design ACP based In-Vehicle Networks(IVNs), selection of ACPs for various application in Automotive
4. Know the industry standard practices for ECU design for automotive, modeling and analysis of application software for ECU design and development, design of ECUs for automobiles, design of HIL and fault diagnostics

Course Outcomes:

On completion of the course the student will be able to:

1. Implement and Interface sensors and for various automotive applications (a,b)
2. Design and diagnose the faults in the systems Implement automotive fault diagnostics and faults. (a,b,d)
3. Analyze on and off board diagnostics, diagnostics protocol (a,b,d)

Mapping of Course Outcomes with Program Outcomes

Course Code	POS/ COs	PO 1	P2	PO 3	PO 4	PO 5	PO 6	P7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
MTDC16F3 200	CO1	2	3										**2**	**1**	
	CO2	2	2		3								**2**	2	
	CO3	1	2		**3**								**2**		**3**

Course Contents:

UNIT 1: Automotive Industry and Modern Automotive Systems [12]

Vehicle classifications and specifications, need for electronics in automobiles,
Automotive Fundamentals Overview – Four Stroke Cycle, Engine Control, Spark and Compression Ignition Engines, Ignition systems, Spark plug, Spark pulse generation, Ignition Timing.
Transmission Control - Automotive transmissions, Drive Train, Brakes, Steering System - Steering Control, Starting System- Battery, Air/Fuel Systems, Fuel Handling, Air Intake System, Lighting

UNIT2: Introduction to Automotive Sensors and Instrumentation [12]

Sensors and actuators,Air/ Fuel Management Sensors – Oxygen (O2/EGO) Sensors, Throttle Position Sensor (TPS), Engine Crankshaft Angular Position (CKP) Sensor, Magnetic Reluctance Position Sensor, Engine Speed Sensor, Ignition Timing Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Manifold Absolute Pressure (MAP) Sensor - Strain gauge and Capacitor capsule, Engine Coolant Temperature (ECT) Sensor, Intake Air Temperature (IAT) Sensor, Knock Sensor, Airflow rate sensor, Throttle angle sensor,Sensors in Engine control, adaptive cruise control, braking control, traction control, steering, stability, Lighting, wipers, climate control, Sensors for occupant safety,Sensor and actuator interfacing techniques and electronic displays.
Actuators – Fuel Metering Actuator, Fuel Injector, Ignition Actuator

UNIT 3: Control Systems [12]

Exhaust After-Treatment SystemsAIR, Catalytic Converter, Exhaust Gas Recirculation (EGR), Evaporative Emission Systems.

Electronic Engine Control – Engine parameters, variables, Engine Performance terms, Electronic Fuel Control System, Electronic Ignition control, Idle sped control, EGR Control.
Communication – Serial Data, Communication Systems, Power windows, Remote keyless entry systems, GPS,Automotive Communication Protocols, Protection, Body and Chassis Electrical Systems, Remote Keyless Entry,
Vehicle Motion Control – Cruise Control, Chassis, , Power Brakes, antilock braking systems, Electronic stability and other technologies, Traction Control, Electronic Stability Control, Electronically controlled suspension, Fundamentals of electronically controlled steering system, Power Steering,

UNIT 4: Safety and Convenience **[12]**
Electronics for Passenger Safety and ConvenienceSIR, Air bag and seat belt pretension systems, Tire pressure monitoring systems.
Automotive Instrumentation – Sampling, Measurement & Signal Conversion of various parameters
Integrated Body – Climate Control Systems, Electronic HVAC Systems,Lighting, Entertainment Systems
Automotive Diagnostics – Timing Light, Engine Analyzer, Process of Automotive Fault Diagnostics, Fault Codes, On-board diagnostics, Off-board diagnostics, Expert Systems.
Future Automotive Electronic Systems – Alternative Fuel Engines, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Radio navigation, Advance Driver Information System, AFS.

Reference Books:

1. Denton. “**Automotive Electrical and Electronic Systems, Burlington**”, MA 01803, Elsevier Butterworth-Heinemann, 2004.
2. Ronald K. Jurgen. “**Automotive Electronics Handbook**”, 2nd Edition, McGraw-Hill, 2007
3. Christian Kohler, “**Enhancing Embedded Systems Simulation**”, Vieweg+TeubnerVerlag/ Springer, 2011.
4. Gabriela Nicolescu and Pieter J. Mosterman, “**Model-Based Design for Embedded Systems**”, CRC Press, 2010
5. Gilbert Held, “**Inter- and Intra-Vehicle Communications**”, CRC Press, 2007.
6. William B. Ribbens, “**Understanding Automotive Electronics**”, 5th Edition, Newnes, 2006
7. Bosch, “**Automotive Electrics & Electronics**”, Robert Bosch GmbH, 3rd Edition, 1999.

DO'S AND DON'TS

DO'S

- Maintain discipline and respect the rules and regulations of the university
- Be regular and punctual to classes
- Study regularly and submit assignments on time
- Be respectful to your colleagues/friends and hostel staff/management.
- Read the notice board (both at your college and the hostel) regularly.
- Utilize your Personal Computer for educational purpose only.
- Follow the code of conduct.
- Visit Health Center on the campus whenever you are unwell.
- Be security conscious and take care of your valuables especially Cash, Mobile Phones,
- Laptop and other valuables.
- Carry your valuables along with you whenever you proceed on leave/vacation.
- Use electric appliances, lights and water optimally.
- Keep the campus clean and hygienic.

DON'TS

- Ragging inside / outside the campus.
- Possession of Fire arms and daggers etc.
- Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
- Use of Crackers, explosives and ammunition etc.
- Smoking and keeping any kind of such items.
- Misusing college & hostel premises/facilities for activities other than studies.
- Playing loud music in the room which may disturb studies of colleagues / neighbours.
- Making noise and raising slogans.
- Keeping electrical appliances, other than authorized ones.
- Involvement in politics, ethnic, sectarian and other undesirable activities.
- Proxy in any manner.
- Use of mobiles in the classrooms.

Note: 1. Rules are revised / reviewed as and when required.
2. Healthy suggestions are welcome for betterment of Institution

REVA UNIVERSITY

STUDENTS HANDBOOK

B.ARCH 2017-2021 BATCH

SCHOOL OF ARCHITECTURE

2017-2021

Rukmini Knowledge Park, Kattigenahalli Yelahanka, Bangalore 560064

- +91- 90211 90211 /080-46966966
- info@reva.edu.in

MESSAGE FROM THE HON'BLECHANCELLOR

Dr. P.Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "KnowledgeSociety" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigm shift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests and to develop your career prospects. You will benefit from a unique approach to student-centered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven commerce courses after studying the market situation in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stakeholders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills to opt for different job prospects across the global.

I hope that the scheme of instructions, continuous periodic progress assessments, course curriculum of **Bachelor of Architecture** and other information provided in this handbook will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centered teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs, and proud citizens of the country.

I wish you every success in your career.

Dr. P. Shyama Raju
Chancellor,
REVA University

MESSAGE FROM THE VICE-CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the real-world experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatest and fascinating priorities and challenges today.

All the programs in REVA University are designed with great care and after detailed market survey of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn andbuild competencies needed in this knowledge-based society. It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects. It facilitates cross cultural learning. It further facilitates students to move on a fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the university. They willcertainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing a brief information about B. Arch, scheme of instruction, course content, CBCS-CAGP regulations and its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed and to work hard and make use of enormous resources and expertfaculties in REVA to accomplish all round development of their personalities and succeed with flying colours not only in earning degree but also in their future career as leaders and proud citizens of mother India.

Dr. V.G.Talawar
Vice-Chancellor

MESSAGE FROM THE PRINCIPAL DIRECTOR

The curriculum of an institution of higher learning is a living entity. It evolves with time; it reflects the ever changing needs of the society and keeps pace with the growing talent of the students and the faculty. The curriculum of the B. Arch, B. Tech, M. Tech and other programs of REVA University is no exception.

An experience of a decade in preparing graduates and postgraduates in engineering, architecture, law, commerce and science for a wide variety of industries & research level organizations has led to creation of the new curriculum. I sincerely believe that it will meet the aspirations of all stake holders – students, faculty and the employers of the graduates and postgraduates of REVA University.

The curriculum has been designed in such a way that the teacher enjoys freedom to expand it in any direction he feels appropriate and incorporates the latest knowledge and stimulates the creative minds of the students. There is also provision for new experiments with new contents andnew techniques. This is going to lead to new teaching – learning paradigm with experiential, experimental & industry relevant approaches. The present curriculum is contemporary because it is culmination of efforts of large number of faculty members, experts from industries and research level organizations. An effort of benchmarking this curriculum with curriculum of other institutionsof repute like NITs and IITs has been done.

I am very sure that all students of REVA University enjoy this curriculum and take fullest advantage to expose themselves to fundamentals and applications. Also, imbibe all attributes that are required to term them as Global Engineers. The innovativeness and creativity being introduced should be explored fully by our students.

The flexibility in the curriculum permits staff and students to incorporate changes in terms of addition of new courses and deletion of irrelevant courses keeping the rapid advances in the technology into consideration.

I also record my personal gratitude to Chancellor, Vice chancellor and members of Academic Senate who have lent every bit of their wisdom to make this curriculum truly superior.

Dr. S. Y. Kulkarni
Principal Director

Director's Message

"A great building must begin with the immeasurable, must go through measurable means when it is being designed, and in the end must be unmeasured". – Louis Kahn

"Architecture is bound to situation. In a strange way, architecture is really an unfinished thing, because even though the building is finished, it takes on a new life. It becomes part of a new dynamic: how people will occupy it, use it, think about it." - Daniel Libeskind.

Above two quotes call for greater ability to analyze, synthesize and evaluate building design factors in order to produce efficient and effective architectural design solutions which satisfy performance, production and procurement criteria.

Architecture can be described as the design of the human environment, mostly buildings, groups of buildings and often the spaces between the buildings. The design, the documentation of designs, the inspection of the construction of buildings, their urban context, their gardens, their interiors and sometimes their furniture - all form part of the activities of the architect. Architectural design projects range in size and complexity from small alterations for a single house to large, multi-level commercial, industrial or public buildings and building complexes or even parts of cities.

Architects are expected to develop and practice a wide variety of skills. Apart from design and planning skills, architects should have technical, problem-solving, managerial, communication, co-ordination and entrepreneurial abilities too. Since not every person would possess all these skills, architects will have to work in groups bringing together experts with different skills and thereby the project undertaken gains greater success as each one would concentrate on those aspects in which he/ she is best. However, this requires team spirit, coordination and cooperative work culture.

Persons in the architectural profession serve clients, who might need buildings for themselves, or who could represent users, e.g. hospitals, schools, community centers or private corporations. They assist clients in drawing up a brief plan for their needs with the assistance of quality surveyors, engineers and project managers. They then prepare design schemes and models, cost projections, project documentation, submit sanction plans for approval by the authorities, acquire tenders and then administer the building contract. Besides time spent in office, the architects do site visits and are in constant contact with clients and coordinate with many disciplines active in the building process.

The B. Arch program in REVA is designed keeping in view the current situation highlighted above and possible future developments, both at national and global levels. The Scheme of Instruction and Curriculum is prepared by the Board of Studies consisting of notable architects, designers and scholars in the field and allied fields. Greater emphasis is laid on studio practice, field study and tutorials.

The B Arch program of the university intends to teach students apart from other things, the conceptualization of designs, test assumptions, evaluation of results and refinement of craft. Students will have access to electives drawn from across disciplines in art, digital design, sustainability and urban design. This flexibility is supported by a rigorous core program of core units in studios, history and theory, communications, technology and design workshops. Students will be given an exposure to the areas of building materials, photography, painting, sculpture, public art and more. The program aims to improve student's aesthetic judgments and facilitate with exposure to a wide range of techniques and media.

The program is to be under CBCS and CAGP system where students will have opportunity to choose the subjects of their interest from wide era of subjects as soft core & open elective.

The personal and professional interests in architecture are matched by our faculty discipline-leading research, providing manifestation of contemporary issues throughout the degree. Our well qualified, experienced and committed faculty will guide you, monitor your progress, mould you and make your study interesting and fruitful. Exciting opportunities will be available for students to expand studio experience, participate in design and build projects and leverage the knowledge and skills of proficient teachers. The facilities for curricular and co-curricular activities in REVA with dedicated supportive staff provide you conducive ambiance for learning.

As architects must also be aware of the social context in which their designs are created, interpreted and understood, teaching to students will not be limited to architectural practice, instead induces to be responsive and adaptive thinkers who can produce designs that meet clients' needs as well as cater to larger environmental concerns.

The university fully understands that engagement with these professionally relevant aspects of the architectural profession is what will make our graduates highly sought-after and our alumni, industry leaders.

I am sure the students choosing B Arch in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teacher's involvement and guidance. We will strive to provide all needed comfort and congenial environment for your studies. I wish all students pleasant stay in REVA and grand success in their career.

The curriculum caters to and has relevance to local, regional, and national, global development needs. Maximum number of courses are integrated with cross cutting issues relevant to professional ethics, gender, human values, environment & sustainability.

Prof B. S Jagadeesha Chandra
Director
School of Architecture

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance ofthese objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Architecture, Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notch educational institutions was born of the philanthropic instinctsof Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 11,000 students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 42 acres of land equipped with state-of-the-art infrastructure and conductive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and other staff.

Currently, REVA University offers 18 Post Graduate programs and 15 Graduate programs and PG Diploma in Engineering, Science and Technology, Commerce and Management Studies, Arts and Humanities, Architecture, Law in addition to research degrees leading to PhD in different disciplines. The University aims to offer many more PG and UG programs in various disciplines including Education, medical and Paramedical Sciences.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula.

The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

ABOUT SCHOOL OF ARCHITECTURE

The School of Architecture has highly experienced faculty members specialized in Architecture and is aligned field and supported by well experienced architects as visiting faculty members. The school has the state-of-art class rooms and well equipped laboratories, drawing and seminar halls, museum space and construction yard. Supported by Divya Sree a noted Infrastructure Development Group, there are lot of opportunities for students to visit, to study, to share and experience on site teaching - learning. The school offers B Arch program. The curriculum of graduate degree program has been designed to bridge the gap between industry – academia and hence they are practical oriented. The B. Arch program aims to prepare human resources to playa leading role in the competitive architecture and construction field and excel in their endeavors. The program also focuses on research and design in the core and allied fields like Interior design, architectural design, climatology, etc., to create a sustainable world and to enhance the global quality of life by adopting enhanced techniques of design and application. This is reflected in various core subjects offered in the program.

Vision

To make the School known for highest level academic standards in inculcating necessary skills and national pride in students to address societal issues through technology.

Mission

To create a team of competent young Architects of high caliber committed to their profession with ethics who can contribute to Architecture and allied fields in optimizing the usage of resources globally making the world eco-friendlier to live in.

Program Education Objectives

The Architecture Graduates from REVA University after 3-5 Years of completion of the programme shall:

1. Demonstrate as successful professional architect with moral, ethical values and innovative ideas.
2. Serve as a leader through consultancy, extension activities and adopt lifelong learning philosophy for continuous improvement.
3. Acquire higher degrees to lead in education, research, and specialized professional service.

Programme Specific Outcomes

On successful completion of the program the student will be able to:

1. Assimilate the knowledge of Socio cultural, technical, environmental, and legal aspectsrelevant to the design of human habitat.
2. Analyze and design sustainable solutions for the built and unbuilt environment.
3. Demonstrate the ability to use contemporary tools and techniques to solve real life problems related to our habitat.

Advisory Board

S. No.	Name	Designation
1	Ar. Dinesh Verma	Managing Director, Ace Group Architects Pvt. Limited, Bangalore
2	Ar.Itty.Zachariah	Managing Director, Zacharia Consultants, Bangalore
3	Ar. JaisimKrishnarao	Managing Director, Fountainhead, Former Chairman, Indian Institute of Architects
4	Ar. H.C.Thimmaiah	Managing Director, Thimmaiah Associates, Ex-President Indian Institute of Architects, Bangalore
5	Ar. H.S. Anantharaman	Managing Director, Anantharam Associates, Visiting Faculty, MSRIT, Bangalore
6	Ar. Bindumadhav	Former Dean, School of Architecture, Mysore University, Mysore
7	Ar.VidyadharWodeyar	Managing Director, Arch Plan, Former Chairman, Indian Institute of Architects, Bangalore

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Degree / Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.

- Students may benefit much from selecting the right options to successfully face the public service examinations like UPSC, KPSC, IES wherein the knowledge of additional subjects become mandatory for general or optional papers.
- Students are exposed to the culture of universal brotherhood during their campus life.
- Students are allowed to practice various methods of learning a subject.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Engineering Graduate Degree Programs, 2016

1. **Teaching and Learning Process:**
   The teaching &learning process under CBCS – CAGPof education in each course of study will have four components, namely**:**

   (i) L= Lecture (ii) T= Tutorial (iii) P=Practice, (iv) D=Dissertation / Project; where:

   L stands for **Lecture** session consisting of classroom instruction.
   T stands for **Tutorial** session consisting participatory discussion / self study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.
   P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.
   D stands for Dissertation / Project to be carried out as a part of the course work.

2. **Courses of Study and Credits**
   a. The study of various subjects in B Tech degree program are grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

   b. In terms of credits, every **one hour session of L amounts to 1 credit per Semester.** In terms of credits, every **one hour session of L amounts to 1 credit per Semester** and a minimum of **two hour session of T or P amounts to 1 credit per Semester or a three hour session of T / P / D amounts to 2 credits** over a period of one Semester of 16 weeks for teaching-learning process.

c. **The total duration of a semester is 20 weeks inclusive of semester-end examination.**

d. **A course shall have either or all the four components.** That means a course may have only lecture component, or only practical component or combination of any two orall the three components.

e. The total credits earned by a student at the end of the semester upon successfully completing the course are L + T + P + D. **The credit pattern of the course is indicated as L: T: P:D.**

Different C**ourses of Study** are labeled and defined as follows:

a. Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Foundation Course, (ii) Hard Core Course, and (iii) Soft Core Course.

b. Foundation Course (FC):

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

c. Hard Core Course (HC):

The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any that the candidates have to complete compulsorily.

d. Soft Core Course (SC):

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branchof study which supports the main branch of study.

e. Open Elective Course:

An elective course chosen generally from other discipline / subject, with an intention to seek exposure to the basics of subjects other than the main discipline the student is studying is called an O**pen Elective Course.**

f. Project Work / Dissertation:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A project work carrying **FOUR or SIX** credits is called **Minor Project** work / **Dissertation.** A project work of **EIGHT, TEN,TWELVE or SIXTEEN** credits is called **Major Project** work / **Dissertation**. **A Minor Project work may be a hard core or a Soft Core as decided by the BoS / concerned. Butthe Major Project shall be Hard Core.**

3. **Scheme, Duration and Medium of Instructions:**
   1. B Arch degree program is of 10 semesters - 5 years duration. A candidate can avail a maximum of 20semesters - 10 years as per double duration norm, in one stretch to complete B Arch degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.
   2. The medium of instruction shall be English

4. **Minimum Credits to be Earned**

4.1 A candidate has to earn 240 credits for successful completion of B Arch degree with the distribution of credits for different courses as prescribed by the university. A candidate can enroll for a maximum of 30 credits and a minimum of 20 credits per Semester. However he / she may not successfully earn a maximum of 30 credits per semester. This maximum of 30 credits does not include the credits of courses carried forward by a candidate.

4.2 Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to Xsemester and complete successfully 240credits in 10 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.3. Add- on Proficiency Certification:

To acquire **Add on Proficiency Certification** a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 240 credits for the B Arch Degree program.

4.3.1. Add on Proficiency Diploma:

To acquire **Add on Proficiency Diploma,** a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 240credits for the B Arch Degree program.

The A**dd on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5. Continuous Assessment, Earning of Credits and Award of Grades.

5.1. The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester is divided into 3 components as C1, C2, and C3.**

5.2. The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

a) Continuous assessment (C1 and C2) = 50 marks

b) Semester end (C3) examination = 50 marks

5.2.1 (i) Component C1:

The first Component (C1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for C2 immediately after completion of process of C1. The finer split - up for the award of marks in C1 is as follows:

Assignment / Seminar .... 10 marks for Unit 1&2

Review Test (Mid-Term)................................. 15 marks for Unit 1&2

Total .... 25 marks

5.2.2 (ii) Component C2:

The second component (C2), of assessment is for 25marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

The 17th week will be for revision of syllabus and preparation for the semester - end examination.

The finer split - up for the award of marks in C2 is as follows:

Assignment / Seminar .... 10 marks for Unit 3 & 4

Review Test (Mid-Term)............................. 15 marks for Unit 3 & 4

Total 25marks

5.2.3 The outline for continuous assessment activities for Component-I (C1) and Component-II (C2) will be proposed by the teacher(s) concerned before the commencement of the semester and will be discussed and decided in the respective School Board. The students should be informed about the modalities well in advance. **The evaluated courses/assignments during Component I (C1) and Component II (C2) of assessment are immediately returned to the candidates after obtaining acknowledgement in the register maintained by the concerned teacher for this purpose.**

5.2.4 (iii) Component C3:

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

Valuation will be undertaken concurrently and results are announced latest by the end of 20^{th} week. This practice will be followed both in odd semester and even semester.

5.3. Evaluation of Practical/Studio Courses

5.3.1 A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

5.3.2. In case a course is fully of P type (L=0:T=0:P=4), the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a. Continuous assessment (C1 and C2) = 50 marks
b. Semester end (C3) practical examination = 50 marks
(Viva voce or Term work)

The 50 marks meant for continuous assessment shall further be allocated as under:

i	C1	Periodic progress and progress reports	25 marks
ii	C2	Periodic progress, final work	25 marks
		Total	**50 marks**

The 50 marks meant for Semester End (C3) Examination, shall be allocated as under:

i	Evaluation of the work – concept etc	20 marks
ii	Drawings, models, presentation, verbal presentation	30 marks
	Total	**50 marks**

5.3.3 The C3 examination for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for C3 component will be as decided by the BoS concerned.

5.3.4 The duration for semester-end practical examination shall be decided by the concerned School Board.

5.4. Evaluation of Minor Project / Major Project / Dissertation:

5.4.1. Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

Component – I	(C1)	Periodic Progress and Progress Reports (25%)
Component – II	(C2)	Results of Work and Draft Report (25%)
Component– III	(C3)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

6. Eligibility to Appear C3 (Semester - end) Examination

Only those students who fulfill a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the course(s), as provided in the succeeding sections, shall be eligible to appear for C3 examination.

7. Requirements to Pass the Semester and Provision for Make-up Examination and to Carry Forward the Failed Subjects / Courses:

7.1 Requirements to Pass a Course

A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50; i .e, C1 + C2 + C3) and have to secure a minimum of 45% to declare pass in the course. However, a candidate has to secure a minimum of 25% (15 marks) in C3 which is compulsory.

7.2 Provision for Make- up Examination:

a) For those students who have secured less than 45% marks in C1, C2 and C3 (end semester examination) together; the university shall conduct a make-up C3 examination of both odd semester and even semester together, after the end of even semester and before the commencement of next odd semester.

b) There is no make-up examination for C1 and C2.

c) A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance is also eligible to appear for make-up examination.

7.3 Provision to Carry Forward the Failed Subjects / Courses:

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for C3 examination of failed courses of previous semesters concurrently with odd semester end examinations (C3) and / or even semester end examinations (C3) of current year of study. However,he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester.

Examples:-

a. Student "A" has failed in 1 Course in First Semester and 3 Courses in Second Semester. He / she is eligible to seek admission for Third Semester and appear for C3 examination of 1 failed Course of First Semester concurrently with Third Semester C3 examination. Likewise, he / she is eligible to appear for C3 examination of 3 failed Courses of Second Semester concurrently with Fourth Semester C3 examination. However, he / she has to clear all the failed Courses of First and Second Semesters before seeking admission to Fifth Semester.

b. Student "B" has failed in 2 Courses in Third Semester and 2 Courses in Fourth Semester and has passed in all Courses of First and Second Semesters. He / she is eligible to seek admission to Fifth Semester and appear for C3 examination of 2 failed Courses of Third Semester concurrently with Fifth Semester C3 examination. Likewise he / she is eligible to appear for C3 examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester C3 examination. However, he / she is not eligible to seek admission to Seventh Semester unless he / she passes in all the failed courses of Third and Fourth Semesters.

c. Student “C” has failed in 4 Courses in Fifth Semester but has cleared all the courses in Sixth Semester. He / She has also passed all the courses of First to Fourth Semesters. Student “C” is eligible to seek admission for Seventh Semester and appear for C3 examination of 4 failed Courses of Fifth Semester concurrently with Seventh Semester C3 examination. However, he / she has to pass all the failed courses of Fifth Semester along with Seventh and Eighth Semesters courses to earn B Tech Degree.

d. Student “D” passed in 1to 4 semesters, but failed in 3 courses of 5th Semester and in 1 course of 6th Semester. He / She has also passed all the courses of First to Fourth Semesters. Student “D” is also eligible to seek admission for 7th Semester and appear for C3 examination of 3 failed courses of 5th Semester concurrently with 7th Semester C3 examination and one failed course of 6th Semester concurrently with 8th Semester C3 examination. However, he / she has to pass all the 3 failed courses of Fifth Semester and 1 course Sixth Semester along with Seventh and Eighth Semester courses to earn B Tech Degree.

7.4 Re-Registration and Re-Admission:

a) In case a candidate’s class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is considered as dropped the semester and is not allowed to appear for end semester examination (C3) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) In case a candidate fails in more than 4 courses in odd and even semesters together in a given academic year (and is detained from moving to higher semester) he / she may opt to re-register either for the entire semester(s) or for such courses wherein, he / she has failed and repeat the semester(s) / courses. (However, such a candidate may also opt to re-appearduring subsequent semester / year within a stipulated period, for C3 (semester end) examination to such of those courses that he /she has failed without re-registering).

c) In such a case where in a candidate drops all the courses in semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

8. Attendance Requirement:

8.1 All students must attend every lecture, tutorial and practical classes.

8.2 In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

8.2 Any student with less than 75% of attendance in aggregate of all the courses including practical courses / field visits etc, during a semester shall not be permitted to appear to the end semester (C3) examination and such student shall seek re-admission as provided in 7.8.4.

8.3 Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

9 Absence during Mid Semester Examination:

In case a student has been absent from a mid semester (C1 and C2) examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and permit such student to appear for make-up mid semester (C1 and C2) examination.

9.1 Absence during End Semester Examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies and has fulfilled the minimum 75% attendance requirement, he / she is permitted to appear for make-up examination.

10 Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an applicationalong with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. This challenge valuation is only for C3 component.

b. The answer scripts for which challenge valuation is sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from firstvaluation and challenge valuation shall be the final.

11 Grade Card and Grade Point

11.1 **Provisional Grade Card**: The tentative / provisional grade card will be issued by the Registrar(Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

11.2 **Final Grade Card:** Upon successful completion of B Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

11.3 **The Grade and the Grade Point:** The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	V*5.5	C
45-49	5	v*5	P
0-44	0	v*0	F
ABSENT			AB

O – Outstanding, A+ - Excellent, A- Very good, B+ - Good, B – Above average, C- Average, P – Pass, F-Fail

Here, P is the percentage of marks (P=[(C1+C2)+M] secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

11.3.1 Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)
The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e :**SGPA (Si) = ∑(Ci x Gi) / ∑Ci**where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**4**	**A+**	**9**	**4X9=36**
Course 2	**4**	**A**	**8**	**4X8=32**
Course 3	**3**	**B+**	**7**	**3X7=21**
Course 4	**3**	**O**	**10**	**3X10=30**
Course 5	**3**	**P**	**5**	**3X5=15**
Course 6	**3**	**B**	**6**	**3X6=18**
Course 7	**2**	**O**	**10**	**2X10=20**
Course 8	**2**	**A**	**8**	**2X8=16**
	24			**188**

Thus, **SGPA = 188 ÷ 24 = 7.83**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	**4**	**A**	**8**	**4X8=32**
Course 2	**4**	**B+**	**7**	**4X7=28**
Course 3	**3**	**A+**	**9**	**3X9=27**
Course 4	**3**	**B+**	**7**	**3X7=21**
Course 5	**3**	**B**	**6**	**3X6=18**
Course 6	**3**	**P**	**5**	**3X5=15**
Course 7	**2**	**B+**	**7**	**2X7=21**
Course 8	**2**	**O**	**10**	**2X10=20**
	24			**175**

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			199

Thus**, SGPA = 199 ÷ 24 = 8.29**

11.4 Cumulative Grade Point Average (CGPA):

11.4.1 Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (240) for B. Arch degree in Architecture is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e :**CGPA = ∑(Ci x Si) / ∑Ci**

Where *Si* is the SGPA of the ith semester and *Ci* is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
Illustration:

CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96
3	24	8.11	24 x 8.11 = 192.64
4	24	7.40	24 x 7.40 = 177.6
5	24	8.29	24 x 8.29 = 198.96
6	24	8.58	24 x 8.58 = 205.92
7	24	9.12	24 x 9.12 = 218.88
8	24	9.25	24 x 9.25 =222.00
9	24	9.35	24x9.35=224.40
10	24	9.50	24x9.50=228.00
Cumulative	240		2007.28

Thus, **CGPA** =
24x6.83+24x7.29+24x8.11+24x7.40+24x8.29+24x8.58+24x9.12+24x9.25 24x9.25 24x9.50 = 8.36
240

11.4.2 CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.36 x 10=83.6

11.5 Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by thecandidate and is given as follows.

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
>5 CGPA< 5.5	5.5	C	Average	
>4.5 CGPA<5	5	P	Pass	Satisfactory

Overall percentage=10*CGPA

12 Provision for Appeal

If a candidate is not satisfied with the evaluation of C1 and C2 components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, testpapers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

Programme Outcomes

- On successful completion of the Programme the student shall be able to:
- Assimilate the fundamental knowledge of history, culture, technical and legal aspects to address environmental and social needs.
- Apply perceptive, aesthetic, and creative abilities to design innovative solutions in the global context.
- Identify and formulate a design problem by applying analytical reasoning and critical thinking.
- Demonstrate the ability to deliver a project using contemporary techniques and tools.
- Demonstrate effective visual, written and verbal communication skills.
- Perform all professional responsibilities independently and as a team member with leadership skills and ethical values.
- Develop an aptitude towards research and critical evaluation.
- Develop the ability to choose appropriate online programmes and participate in conferences and seminars to be a life-long learner.

Course Numbering Scheme

BR17AR1100 – Architectural Design I

BR	AR	15	F	1	1	00
Program code B Arch	Discipline Code - Architecture	Year of introduction of curriculum	Full time candidate	1st Semester	Course number	Elective number

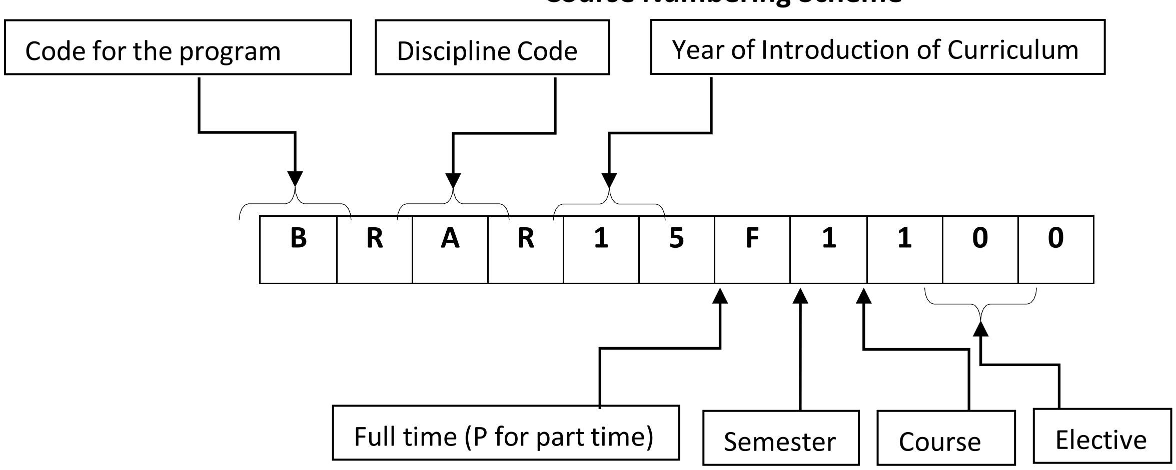
AR15F3930 – Hindu, Buddhist & Colonial Architecture – S E Asia

BR	AR	15	F	3	9	30
Program code B Arch	Discipline Code - Architecture	Year of introduction of curriculum	Full time candidate	3rd Semester	Course number	Elective number

AR16F1400 – History of Architecture I

BR	AR	16	F	1	4	00
Program code B Arch	Discipline Code - Architecture	Year of introduction of curriculum	Full time candidate	1st Semester	Course number	Elective number

Course Numbering Scheme



List of Code for Program and Discipline / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BR	B. Arch (Bachelor of Architecture)	AR	ARCHITECTURE

TRAINING AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

The REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling, Training and Placement (CCTP) Centre headed by well experienced dynamic Trainer, Counselor and Placement Officer supported by an efficient team does handle all aspects of Internships and Placement for the students of REVA University. The prime objective of the CCTP Centre is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CCTP Centre organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CCTP Centre forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Engineering is efficient leaders of repute, who can deal the real time problems with a flavor of innovation. This kept in focus, the Training and Placement cell has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his/her interest and march forward to make better career. Skill development is one of the very important activities of the University and Industry relationship. A skill development center is established to organize skill and certification programs. The students shall compulsorily complete at least two skill/certification based programs before the completion of the degree.

The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs.

The various skill/certification programs identified are as follows.

- Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX
- Red-hat certified programs on LINUX,
- Management related programs like SAP,ERP and Business Analytics
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration
- IBM certified programs.

The University has signed MOU's with Multi-National Companies, research institutions, Government agencies like NSDC (National Skill Development Corporation) and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

Mapping of Course Outcomes with programme Outcomes

semester	Course code	Name of course		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
sem 1	BR17AR101	Architectural Design - I	CO1	3	0	3	1	1	2	0	1	2	2	2
			CO2	0	0	0	0	2	2	1	0	1	0	3
			CO3	0	1	4	2	1	2	0	0	1	2	3
			CO4	0	1	2	1	1	2	1	0	1	1	0
	BR17AR102	Building Construction materials - I	CO1	3	3	3	2	2	1	0	2	3	3	2
			CO2	1	2	2	4	2	2	0	4	2	2	1
			CO3	0	2	2	3	2	3	0	3	4	3	2
			CO4	1	0	2	3	2	3	0	3	4	3	2
	BR17AR103	*Architectural Graphics - I	CO1	0	2	2	2	1	2	1	1	1	1	2
			CO2	0	2	2	2	1	2	0	1	1	1	2
			CO3	0	2	1	2	1	2	0	1	1	1	3
			CO4	0	3	1	2	1	2	0	1	1	1	2
	BR17AR104	History of Architecture - I	CO1	3	0	1	1	2	2	1	1	3	1	1
			CO2	3	1	1	1	2	2	1	1	3	1	1
			CO3	3	1	1	1	2	2	1	1	3	1	1
			CO4	3	2	1	2	2	2	1	2	3	0	2
	BR17AR105	*Fine Arts/Applied Arts - I	CO1	0	2	2	2	1	2	1	1	1	1	2
			CO2	0	2	2	2	1	2	0	1	1	1	2
			CO3	0	2	1	2	1	2	0	1	1	1	3
			CO4	0	3	1	2	1	2	0	1	1	1	2
	BR17AR106	Structures - I	CO1	2	1	1	2	2	2	0	2	1	1	2
			CO2	2	2	1	2	2	2	0	2	1	1	2
			CO3	2	2	1	2	2	2	0	2	1	1	2
			CO4	2	2	1	2	2	2	0	2	1	1	2
	BR17AR107	Communication Skills	CO1	0	0	0	3	3	0	0	3	0	0	3
			CO2	0	1	3	3	3	0	0	0	0	0	3
			CO3	0	0	0	3	3	0	0	0	0	0	3
			CO4	0	3	0	0	0	3	0	0	0	0	3

sem 2	BR17AR201	Architectural Design – II	CO1	1	3	2	1	1	2	1	1	2	2	1
			CO2	0	3	3	1	1	2	1	1	1	2	1
			CO3	1	2	2	2	1	2	1	1	2	2	1
			CO4	3	3	2	1	1	2	2	1	3	2	1
	BR17AR202	Building Construction materials - II	CO1	3	3	3	2	2	1	0	2	3	3	2
			CO2	1	2	2	4	2	2	0	4	2	2	1
			CO3	0	2	2	3	2	3	0	3	4	3	2
			CO4	1	0	2	3	2	3	0	3	4	3	2
	BR17AR203	*Architectural Graphics- II	CO1	0	2	1	2	1	2	0	1	1	1	2
			CO2	3	2	1	2	1	2	0	1	1	1	3
			CO3	3	2	1	2	1	2	0	1	1	1	3
			CO4	0	2	1	2	1	2	0	1	1	1	2
	BR17AR204	History of Architecture - II	CO1	3	0	2	0	1	1	1	1	3	0	0
			CO2	3	0	3	1	2	1	2	0	3	1	0
			CO3	2	2	3	1	2	1	2	0	2	1	1
			CO4	1	1	2	0	2	1	1	0	1	1	1
	BR17AR205	Theory of Design - I	CO1	2	3	1	2	1	2	0	1	2	2	2
			CO2	3	3	1	2	1	2	0	1	3	3	2

			CO3	1	3	1	2	1	2	0	1	1	2	2
			CO4	2	3	2	2	1	2	0	1	1	3	2
	BR17AR206	Structures – II	CO1	2	3	1	2	1	2	0	1	2	2	2
			CO2	3	3	1	2	1	2	0	1	3	3	2
			CO3	1	3	1	2	1	2	0	1	1	2	2
			CO4	2	3	2	2	1	2	0	1	1	3	2
	BR17AR207	Fine Arts/Applied Arts - II	CO1	2	3	1	2	1	2	0	1	2	2	2
			CO2	3	3	1	2	1	2	0	1	3	3	2
			CO3	1	3	1	2	1	2	0	1	1	2	2
	BR17AR208	Art Appreciation & Photography	CO1	2	3	1	2	1	2	0	1	2	2	2
			CO2	3	3	1	2	1	2	0	1	3	3	2
			CO3	1	3	1	2	1	2	0	1	1	2	2
	BR17AR301	*Architectural Design – III	CO1	3	2	3	2	1	2	2	1	3	1	3
			CO2	2	3	3	2	1	2	2	1	2	3	3
			CO3	0	1	2	2	1	2	1	1	2	2	3
			CO4	1	1	2	2	1	2	1	1	2	2	3
	BR17AR302	*Building Construction materials – III	CO1	2	1	1	2	2	2	0	2	1	1	2
			CO2	2	2	1	2	2	2	0	2	1	1	2
			CO3	2	2	1	2	2	2	0	2	1	1	2
			CO4	2	2	1	2	2	2	0	2	1	1	2
	BR17AR303	*Architectural Graphics–III	CO1	0	2	1	2	1	2	0	1	1	1	2
			CO2	3	2	1	2	1	2	0	1	1	1	3
			CO3	3	2	1	2	1	2	0	1	1	1	3
			CO4	0	2	1	2	1	2	0	1	1	1	2
	BR17AR304	Theory of Design - II	CO1	3	2	1	2	2	0	2	0	3	2	2
			CO2	1	3	2	1	1	0	2	0	1	3	3
			CO3	1	3	3	2	3	0	2	0	1	3	3
			CO4	1	1	2	3	3	0	3	0	1	2	3
	BR17AR305	Structures – III	CO1	1	1	0	1	0	0	0	1	1	2	2
			CO2	1	3	0	1	1	1	0	1	1	1	2
			CO3	1	1	1	1	0	0	0	1	1	1	2
			CO4	1	2	0	1	0	1	0	1	1	1	2
			CO5	1	3	1	1	2	1	1	1	1	2	2
sem 3	BR17AR306	Environment studies	CO1	2	0	2	0	0	2	0	2	3	0	3
			CO2	2	3	0	0	0	0	0	1	3	0	2
			CO3	1	0	2	1	0	2	0	1	3	3	2
			CO4	3	1	2	0	0	0	1	1	0	1	1
	BR17AR307	Constitution of India	CO1	2	0	3	0	1	0	1	1	3	0	3
			CO2	3	0	3	0	0	0	0	3	0	0	3
			CO3	0	0	3	0	0	3	0	0	3	0	3
			CO4	3	0	3	0	0	0	0	3	0	0	3
	BR17AR308	Vacation Assignment:	CO1	2	2	3	2	1	2	1	1	3	2	2
			CO2	4	2	4	1	1	2	2	1	3	2	2
			CO3	5	2	4	2	1	2	2	1	3	2	2
			CO4	2	3	2	2	1	2	1	2	2	3	3
		South India	CO1	4	1	1	0	0	1	0	0	4	1	1
	BR17AR3091		CO2	3	1	1	0	0	1	1	0	3	1	1
			CO3	4	1	1	0	1	1	0	0	4	0	1
		North India	CO1	4	1	1	0	0	1	0	0	4	1	1
	BR17AR3092		CO2	3	1	1	0	0	1	1	0	3	1	1
			CO3	4	1	1	0	1	1	0	0	4	0	1
	BR17AR3093	South East Asia	CO1	4	1	1	0	0	1	0	0	4	1	1
			CO2	3	1	1	0	0	1	1	0	3	1	1
			CO3	4	1	1	0	1	1	0	0	4	0	1
	BR17AR401	*Architectural Design – IV	CO1	`	2	3	2	1	2	2	1	3	1	3
			CO2	2	3	3	2	1	2	2	1	2	3	3
			CO3	0	1	2	2	1	2	1	1	2	2	3
			CO4	1	1	2	2	1	2	1	1	2	2	3
	BR17AR402	*Building Construction Materials – IV	CO1	3	2	3	2	2	2	3	3	2	2	2
			CO2	2	3	3	2	3	3	2	2	3	3	2
			CO3	2	3	3	3	3	3	3	3	2	3	2
			CO4	2	3	3	3	3	3	2	3	3	3	3
	BR17AR403	*Climatology - I	CO1	0	0	0	0	0	0	0	0	0	0	0
			CO2	2	1	3	2	2	2	2	2	3	3	3
			CO3	3	3	3	2	2	2	2	2	3	3	3
			CO4	3	3	3	2	2	2	2	2	3	3	0
	BR17AR404	Building Services – I	CO1	3	3	3	2	1	2	1	2	3	3	3
			CO2	3	3	3	2	1	2	2	2	2	3	3
			CO3	3	2	3	2	1	1	1	2	3	3	3
			CO4	3	2	3	2	1	2	2	2	2	3	3
	BR17AR405	Structures – IV	CO1	1	3	1	1	2	2	1	2	2	2	2
			CO2	1	3	2	1	1	1	1	1	2	2	2
			CO3	1	2	2	1	2	1	0	1	1	2	2
sem 4	BR17AR406	Surveying and Leveling - I	CO1	2	3	3	2	1	2	2	1	3	3	2
			CO2	2	2	4	2	1	2	2	2	2	1	3
			CO3	3	3	2	2	1	2	1	1	2	2	3
			CO4	1	3	3	2	1	2	1	1	2	2	3
	BR17AR407	Computers – I	CO1	1	3	0	2	1	1	0	2	2	2	3
			CO2	1	3	0	2	1	1	0	1	2	2	2
			CO3	1	3	0	2	1	1	0	1	2	1	3
			CO4	0	0	0	0	0	0	0	0	0	0	3
	BR17AR4081	Contemporary-Asia/India	CO1	3	1	2	1	1	1	2	2	3	2	1
			CO2	1	2	3	1	2	2	2	3	2	2	3
			CO3	3	1	2	1	1	1	2	2	2	3	1
			CO4	2	1	2	2	3	2	2	2	2	2	1
	BR17AR4082	Contemporary-Europe & other countries	CO1	3	1	2	1	1	1	2	2	3	2	1
			CO2	1	2	3	1	2	2	2	3	2	2	3
			CO3	3	1	2	1	1	1	2	2	2	3	1
			CO4	2	1	2	2	3	2	2	2	2	2	1
	BR17AR4083	Contemporary-United States	CO1	3	1	2	1	1	1	2	2	3	2	1
			CO2	1	2	3	1	2	2	2	3	2	2	3
			CO3	3	1	2	1	1	1	2	2	2	3	1
			CO4	2	1	2	2	3	2	2	2	2	2	1
	BR17AR501	*Architectural Design – V	CO1	3	1	3	1	1	1	1	1	3	1	2
			CO2	2	3	3	2	1	2	2	1	3	3	2
sem 5			CO3	3	3	2	2	1	2	2	1	3	3	3
			CO4	3	3	2	2	2	2	3	1	3	2	3
	BR17AR502	*Building Construction materials – V	CO1	1	2	1	2	2	2	0	2	1	1	2

			CO2	2	1	1	1	2	2	0	2	1	1	2
			CO3	1	1	1	1	2	2	0	2	1	1	2
	BR17AR503	Energy efficiency in Buildings	CO1	3	1	3	0	2	0	2	2	3	0	0
			CO2	3	3	3	2	2	2	2	2	3	3	3
			CO3	2	2	3	2	2	2	2	2	3	3	3
			CO4	2	3	3	2	2	2	2	2	3	3	3
	BR17AR504	Building Services-II	CO1	3	3	3	2	1	2	1	2	3	3	3
			CO2	3	3	3	2	1	2	2	2	2	3	3
			CO3	3	2	3	2	1	1	1	2	3	3	3
			CO4	3	2	3	2	1	2	2	2	2	3	3
	BR17AR505	Structures – V	CO1	1	3	1	1	2	2	1	2	2	2	2
			CO2	1	3	2	1	1	1	1	1	2	2	2
			CO3	1	2	2	1	2	1	0	1	1	2	2
	BR17AR506	Computers – II	CO1	1	2	1	2	2	1	0	1	2	1	3
			CO2	1	2	0	2	2	1	0	1	2	0	3
			CO3	1	3	0	2	2	1	0	1	2	1	3
			CO4	1	3	0	2	2	1	0	1	2	1	3
	BR17AR507	Vacation Assignment/Study trip/Summer course	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	3	3	2	1	2	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
			CO4	3	2	2	1	1	2	1	1	1	2	2
	BR17AR5081	Vernacular Architecture	CO1	3	1	2	0	1	2	1	1	3	2	2
			CO2	2	3	2	2	3	2	2	2	3	2	3
			CO3	3	3	2	2	3	2	2	1	3	2	0
			CO4	3	3	3	2	3	2	3	2	3	2	3
	BR17AR5082	Conservation	CO1	3	0	2	0	0	3	0	3	3	0	3
			CO2	3	0	0	3	0	0	0	3	3	0	0
			CO3	0	0	0	3	0	3	0	0	3	0	3
			CO4	3	0	0	3	3	0	0	0	3	0	3
	BR17AR5083	Housing	CO1	2	1	3	2	2	2	2	2	4	3	3
			CO2	1	1	3	1	1	2	2	1	3	1	3`
			CO3	1	3	2	2	2	2	2	1	3	2	3
			CO4	4	1	3	2	2	2	2	2	4	2	3
	BR17AR601	*Architectural Design – VI	CO1	3	1	3	1	1	1	1	1	3	1	2
			CO2	2	3	3	2	1	2	2	1	3	3	2
			CO3	3	3	2	2	1	2	2	1	3	3	3
			CO4	3	3	2	2	2	2	3	1	3	2	3
	BR17AR602	*Building Construction, materials & Working Drawings	CO1	1	2	1	2	2	2	0	2	1	1	2
	BR17AR603	Estimation & Costing	CO1	0	0	3	0	1	1	1	0	1	0	0
			CO2	0	1	3	0	1	1	0	0	1	0	1
			CO3	0	2	2	0	1	1	0	1	1	1	0
			CO4	1	1	3	1	1	1	0	0	3	1	0
	BR17AR604	Building Services-III (Mechanical)	CO1	0	1	3	0	1	1	0	0	1	0	1
			CO2	0	2	2	0	1	1	0	1	1	1	0
sem 6			CO3	1	1	3	1	1	1	0	0	3	1	0
	BR17AR605	Structures – VI	CO1	1	1	1	1	2	2	1	1	2	1	2
			CO2	1	1	2	1	2	2	1	0	1	1	1
			CO3	2	2	3	0	2	2	1	3	3	3	1
	BR17AR606	Advanced computer aided design	CO1	1	3	1	1	2	2	1	2	2	2	2
			CO2	1	3	2	1	1	1	1	1	2	2	2
			CO3	1	2	2	1	2	1	0	1	1	2	2
			CO1	1	1	0	2	1	1	0	1	2	1	2
	BR17AR608	Architectural Reseacrh Writing	CO1	1	0	3	3	0	0	3	0	3	3	3
			CO2	1	3	3	3	0	0	3	3	1	3	3
			CO3	2	1	3	3	3	3	3	0	1	3	3
			CO4	0	0	3	3	3	3	3	3	0	2	3
	BR17AR701	Architectural Design VII	CO1	2	1	2	2	0	1	1	2	2	2	1
			CO2	2	2	3	2	1	2	1	1	3	2	2
			CO3	1	1	2	1	2	1	3	3	1	3	1
	BR17AR702	Professional Practice, Values & Ethics-I	CO1	2	1	2	0	1	1	1	1	2	2	2
			CO2	2	2	3	3	1	2	3	2	2	1	2
			CO3	3	2	1	1	0	1	1	1	3	1	1
	BR17AR703	Building Services-II(Acoustics)	CO1	2	0	3	1	2	2	0	1	2	0	3
			CO2	3	0	3	1	0	2	0	3	3	0	1
			CO3	3	0	3	2	2	2	0	1	2	1	3
			CO4	3	1	3	1	3	2	0	3	1	0	2
			CO1	1	0	3	1	2	2	2	1	2	1	2
	BR17AR704	INTERIOR DESIGN	CO1	1	2	3	1	1	2	2	0	2	1	3
			CO2	1	2	3	2	1	2	2	1	2	2	3
			CO3	1	1	3	1	2	2	2	2	2	3	2
			CO4	2	2	2	2	2	3	2	2	2	2	2
	BR17AR7051	Urban Planning	CO1	2	2	2	2	2	2	2	2	3	3	2
sem 7			CO2	3	2	3	2	2	2	2	2	3	3	2
			CO3	3	3	3	2	2	2	2	2	3	3	3
	BR17AR7052	Urban Design	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	0	3	3	1	1	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
	BR17AR7061	System design for sustainability	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	0	3	3	1	1	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
	BR17AR7062	Glass in buildings : Design and applications	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	0	3	3	1	1	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
	BR17AR7063	Integrated Waste Management for a Smart City	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	0	3	3	1	1	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
	BR17AR707	Vacation Assignment/Study trip/Summer course	CO1	3	1	1	0	1	2	1	2	3	1	2
			CO2	0	3	3	1	1	3	2	2	2	1	1
			CO3	3	2	2	1	1	1	2	2	3	1	3
	BR17AR801	Professional Training – I	CO1	3	3	3	2	2	1	2	2	3	3	3
sem 8			CO2	2	3	3	2	2	1	2	2	2	3	3
			CO3	2	2	3	2	2	1	2	2	2	3	3
	BR17AR901	Professional Training – II	CO1	3	3	3	2	2	1	2	2	3	3	3
sem 9			CO2	2	3	3	2	2	1	2	2	2	3	3
			CO3	2	2	3	2	2	1	2	2	2	3	3
	BR17ARX100	Architectural Design Thesis	CO1	3	2	3	2	1	2	2	2	3	2	2
sem 10			CO2	2	2	3	2	1	2	1	2	3	2	2
			CO3	2	3	1	1	2	1	1	1	2	2	3

			CO4	0	2	1	3	2	3	3	1	2	3	2
	BR17ARX200	Construction Management	CO1	1	2	1	2	0	1	0	1	2	2	2
			CO2	1	2	3	2	0	2	0	1	3	1	2
			CO3	1	2	0	2	0	1	0	2	2	1	2
			CO4	1	0	2	2	0	2	0	0	3	2	3
	BR17ARX301	Architecture Journalism	CO1	1	2	1	2	0	1	0	1	2	2	2
			CO2	1	2	3	2	0	2	0	1	3	1	2
			CO3	1	2	0	2	0	1	0	2	2	1	2
			CO4	1	0	2	2	0	2	0	0	3	2	3
	BR17ARX302	Product Design	CO1	1	2	1	2	0	1	0	1	2	2	2
			CO2	1	2	3	2	0	2	0	1	3	1	2
			CO3	1	2	0	2	0	1	0	2	2	1	2
			CO4	1	0	2	2	0	2	0	0	3	2	3

REVA UNIVERSITY SCHOOL OF ARCHITECTURE,
B ARCH DEGREE PROGRAM

SCHEME OF INSTRUCTION FOR FIRST BATCH (2016 to 2020) STUDENTS

FIRST SEMESTER

No	Course Code	Course Title	Type	L/S	T	P	Total Credits	
1	BR17AR101	Architectural Design – I	HC	4	0	2	6	SEE VV
2	BR17AR102	Building Construction materials – I	HC	2	-	2	4	SEE
3	BR17AR103	Architectural Graphics - I	HC	3	-	1	4	SEE
4	BR17AR104	History of Architecture - I	HC	1	-	1	2	SEE
5	BR17AR105	Fine Arts/Applied Arts - I	HC	-	-	2	2	SEE TW
6	BR17AR106	Structures – I	HC	2	-	1	3	SEE
7	BR17AR107	Communication Skills	FC	3	-	-	3	SEE
		Total		**15**	**0**	**9**	**24**	

SECOND SEMESTER

No	Course Code	Course Title	Type	L/S	T	P	Total credits	
1	BR17AR201	Architectural Design - II	HC	4	0	2	6	SEE VV
2	BR17AR202	Building Construction materials – II	HC	2	-	2	4	SEE
3	BR17AR203	Architectural Graphics- II	HC	3	-	1	4	SEE
4	BR17AR204	History of Architecture - II	HC	1	-	1	2	SEE
5	BR17AR205	Theory of Design - I	HC	3	-	-	3	SEE
6	BR17AR206	Structures – II	HC	2	-	1	3	SEE
7	BR17AR207	Fine Arts/Applied Arts - II	HC	-	-	2	2	SEE VV
8	BR17AR208	Art Appreciation & Photography	HC	2	-	-	2	SEE TW
		Total		**17**	**0**	**10**	**26**	

THIRD SEMESTER

No	Course Code	Course Title	Type	L/S	T	P	Total Credits	
1	BR17AR301	Architectural Design – III	HC	4	0	2	6	SEE VV
2	BR17AR302	Building Construction materials – III	HC	2	0	2	4	SEE
3	BR17AR303	Architectural Graphics–III	HC	2	0	1	3	SEE TW

4	BR17AR304	Theory of Design - II	HC	3	0	0	3	SEE
5	BR17AR305	Structures – III	HC	2	0	1	3	SEE VV
6	BR17AR306	Environment studies	FC	1	1	0	2	SEE TW
7	BR17AR307	Constitution of India	FC	2	0	0	2	SEE
8	BR17AR308	Vacation Assignment:	HC	0	0	2	2	SEE VV
	SOFT CORE	**Anyone to be chosen**	**History of Architecture: Hindu and Islamic**					
9a	BR17AR3091	South India	SC	4	0	0	4	SEE VV
9b	BR17AR3092	North India	SC	4	0	0	4	SEE VV
9c	BR17AR3093	South East Asia	SC	4	0	0	4	SEE VV
		Total		20	1	8	29	

FOURTH SEMESTER

No	Course Code	Course Title	Type	L/S	T	P	Total Credits	
1	BR17AR401	Architectural Design – IV	HC	4	0	2	6	SEE VV
2	BR17AR402	Building Construction Materials – IV	HC	2	0	2	4	SEE
3	BR17AR403	Climatology – I	HC	2	0	1	3	SEE TW
4	BR17AR404	Building Services – I	HC	2	0	0	2	SEE
5	BR17AR405	Structures – IV	HC	2	0	1	3	SEE VV
6	BR17AR406	Surveying and Leveling – I	HC	1	0	1	2	SEE
7	BR17AR407	Computers – I	HC	1	0	1	2	SEE TW
	SOFT CORE	**Anyone to be chosen**	**Contemporary Architecture**					
8a	BR17AR4081	India and rest of Asia	SC	4	0	0	4	SEE VV
8b	BR17AR4082	Europe & other countries	SC	4	0	0	4	SEE VV
8c	BR17AR4083	North and South America	SC	4	0	0	4	SEE VV
		Total		**18**	**0**	**8**	**26**	

FIFTH SEMESTER -2016 BATCH

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR501	Architectural Design – V	HC	0	4	2	6	10	SEE VV
2	BR17AR502	Building Construction materials – V	HC	2	2	0	4	6	SEE
3	BR17AR503	Energy efficiency in Buildings	HC	1	1	0	3	3	SEE TW
4	BR17AR504	Building Services-II	HC	2	0	0	2	2	SEE
5	BR17AR505	Structures – V	HC	2	1	0	3	4	SEE VV
6	BR17AR506	Computers – II	HC	1	1		2	3	SEE TW
7	BR17AR507	Vacation Assignment/Study trip/Summer course	HC	0	0	0	2	0	SEE TW
Soft Core - Contemporary Architecture (Any ONE to be Chosen from among the following)									
8A	BR17AR5081	Vernacular Architecture	SC	4	0	0	4	4	SEE VV
8B	BR17AR5082	Conservation	SC	4	0	0	4	4	SEE VV
8C	BR17AR5083	Housing	SC	4	0	0	4	4	SEE VV
Total Credits							26	31	

SIXTH SEMESTER -2016 BATCH

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR601	Architectural Design – VI	HC	0	4	2	6	10	SEE VV

2	BR17AR602	Building Construction, materials & Working Drawings	HC	2	2	0	4	6	SEE
3	BR17AR603	Estimation ,Costing and Specification	HC	3	0	0	3	3	SEE
4	BR17AR604	Building Services-III (Mechanical)	HC	3	0	0	3	3	SEE
5	BR17AR605	Structures – VI	HC	2	1	0	3	4	SEE VV
6	BR17AR606	Advanced computer aided design	HC	1	1	0	2	3	SEE TW
7	BR17AR607	Landscape Architecture	HC	1	1	0	2	3	SEE
8	BR17AR608	Architectural Research Writing	HC	3	1	0	4	4	SEE VV
Total Credits							**27**	**36**	

SEVENTH SEMESTER

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR701	Architectural Design- VII	HC	4	0	4	10	8	SEE VV
2	BR17AR702	Professional Practice, Values & Ethics	HC	1	1	0	2	3	SEE
3	BR17AR703	Building Services-IV (Acoustics)	HC	3	0	0	3	3	SEE
4	BR17AR704	Interior Design	HC	0	1	1	2	3 (0:2:1)	SEE TW
SOFT CORE(Any ONE to be Chosen from among the following)									
5a	BR17AR7051	Urban planning	SC	3	0	0	3	3	SEE
5b	BR17AR7052	Urban Design	SC	3	0	0	3	3	SEE
Choose ONE Open Elective Course – Swayam – Online Certification Course									

6a	BR17AR7061	System design for sustainability	OE	4	0	0	4	4	Online Certification Course
6b	BR17AR7062	Glass in buildings : Design and applications	OE	4	0	0	4	4	
6c	BR17AR7063	Integrated Waste Management for a Smart City	OE	4	0	0	4	4	
7	BR17AR707	Vacation Assignment /Study Trip/Summer Course	HC	2	0	0	2	0	
Total Credits							26	29	

EIGHTH SEMESTER

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR801	Professional Training – I	HC	0	20	4	16	(16 to 18weeks)	SEE VIVA
Total Credits							**16**		

NINTH SEMESTER -2016 BATCH

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR901	Professional Training – II	HC	0	20	4	16	16 to 18 weeks	SEE VIVA
Total Credits							**16**		

TENTH SEMESTER

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17ARX01	Architectural Design Thesis	HC	4	0	12	22	16	SEE VIVA
2	BR17ARX02	Construction Management	HC	1	2	0	2	3	SEE

3	BR17ARX031	Architecture Journalism/	SC	1	2	0	2	3	SEE VV
4	BR17ARX032	Product design	SC	1	2	0	2	3	SEE VIVA
Total Credits							**26**	31	

TOTAL CREDITS OF ALL 10 SEMESTERS = HC = 211; SC = 18; OE = 4; FC = 7; TOTAL= 240

Note-1: Example of Course Numbering Scheme for B. Arch Program

AR16F3930 – Hindu, Buddhist & Colonial Architecture – S E Asia

BR	AR	16	F	3	9	30
Program code B Arch	Discipline Code - Architecture	Batch of Students	Full time candidate	3^{rd} Semester	Course number	Elective number

Note-2: Subject Codes with expansion

HC	Hard Core	SC	Soft Core	FC	Foundation Course	OE	Open elective
L	Lecture	S	Studio	T	Tutorial	P	Practical
	Drawing subjects	VV	Viva voce	SEE	Semester End Exam	TW	Term Work

Course Title	**ARCHITECTURAL DESIGN I**		
Course Code	**BR17AR101**	**IA Marks**	**25+25**
L:T:P	**4:0:2 = 6**	**Exam Hours**	**SEE (Viva Voce)**
Contact Hours per Week	**4:0:4 = 8**	**Exam Marks**	**50**

B ARCH DEGREE PROGRAM

DETAILED SYLLABUS FOR BATCH (2016 to 2021) STUDENTS

COURSE OBJECTIVES:

- Explain the meaning and purpose of design.
- Describe the grammar of design and visual composition.
- Train the students in visual composition using 2D and 3D objects
- Train the students in architectural perception, and visualization.
- Explain the elements and principles of Basic Design as the building blocks of creative design.
- Explain the abstract principles of design and anthropometric studies into architectural solutions.

COURSE CONTENTS:

UNIT-I -

Elements of design: properties, qualities and characteristics of point, line, plane, direction, shape, form, color and texture.Learning importance of line types, characteristics and qualities of line types. Working in layers of each Element until all layers are incorporated into a single composition. Introducing Principles of Design: Balance, proportion, scale, Unity, Variety, Emphasis, contrast, Pattern, Gradation, Dynamism, Positive and Negative. Work in small groups with variety in Materials and mediums choosing between 2D and 3D methods of presenting the idea.

UNIT-II -

Introduction to Anthropometry and its importance as a tool in designing architectural spaces. Work with life size models and compare Indian adaptations and scale with Standards. Erecting a structure to Human scale to understand volume and its relation to anthropometry. Ideating and executing the design in Groups.

UNIT-III –

Emphasis on transformation of conceptual drawings to the 2D drawing; Basics of preparation of plans, elevations, sections and views with an exercise in Measure drawing. Single function space in the immediate environment like Hostel room and toilet or room and toilet at their residence. Individual work.

UNIT-IV –

Design of an architectural space having form and volume or additions/extensions to a built space; representing the same through Plan, Section, Elevation and Models. Student should learn to develop more than one solution to the design and learn the process of selection /elimination. Thought to be given to materials. Importance to be given to understand basics in the representations:Plinth, levels, Entrance porch, sill, lintels, parapets etc. that is learnt in Building construction.

Rendering techniques learnt in Fine Arts-I to be applied in the presentation. Individual work.

COURSE OUTCOMES:

The students should be able to

- Understand the language of Design.

- Apply anthropometry to design of spaces.

Course Title	**BUILDING CONSTRUCTIONS MATERIALS I**		
Course Code	**BR17AR102**	**IA Marks**	**25+25**
L:T:P	**2:0:2 = 4**	**Exam Hours**	**SEE**
Contact Hours per Week	**2:0:4 = 6**	**Exam Marks**	**50**

COURSE OBJECT:

- Introduce drafting, techniques of graphic representations
- Introduce the basic building elements, materials

COURSE CONTENTS:

UNIT-I –

Introduction to drafting and drafting Equipment: Lines, Hatches, Lettering, Scales and basics of sheets composition. Understanding Line weights.

Brick masonry: Basic components of masonry, different types of brick-bonds.

Stone Masonry: Dressing of Stone, application in Building Industry, Types of Stone masonry, methods of Pointing,

UNIT-II –

Arches: Typical arch and its basic components, Ogee arch, semicircular arch, four centered arches

Lintels: R.C.C lintel, Brick lintel, stone lintel.

Piers and Abutments

Understanding support system of Centering, Scaffolding,

Material study: Stone, Bricks, Clay, mud and lime as mortar

UNIT-III –

Foundation: functions of foundations, types of foundations, Simple Stone and Brick foundations for load bearing structures

Material Study: Sand, Fly ash, cement, lime, aggregate. P.C.C, Concrete blocks, Tiles, roof covers

UNIT-IV –

Wooden roofs (flat, sloping): Simple pitched roof, lean to, close collar and couple close roofs with Types of roof trusses, detail study of king post truss and queen post truss.

Super structure: Section through external walls from foundation – showing coping, cornices with different materials. Chajja, parapet, facia, sill, lintel–types, method of construction, purpose etc

Site / field visit: Regular site visits to construction sites and buildings to understand the practical implication of theoretical inputs.

Visits to Brick industry, Stone quarry to study the manufacturing process and related activities.

2 to 4 plates from each unit, sketch book and material portfolio and models to be prepared.

COURSE OUTCOMES:

The students by the end of the course will be able to

- Draft and read architectural drawings using architectural conventions, using appropriate scale, line weights and sheet composition with neat, individualistic lettering styles.
- Identify the basic building components of a building such as brick, mortar, masonry construction, lintels and arches and their construction methods.
- Employ appropriate building materials based on the properties, behavior and applications and identifying the materials for usage in load bearing building.

REFERENCES:

1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushil Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
4. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

Building Construction-W.B.McKay, volumes 1 to 4 , Pearson Publication.

Course Title	ARCHITECTURAL GRAPHICS I		
Course Code	BR17AR103	IA Marks	25+25
L:T:P	3:0:1 = 4	Exam Hours	SEE
Contact Hours per Week	3:0:2 = 5	Exam Marks	50

COURSE OBJECTIVES:

- To enhance drawing, visualization and representation skills
- Familiarize with drawing equipment's like scales, set squares, pencils & its application and uses.
- Explain orthographic projections in relation to architectural drawings & details

COURSE CONTENTS:

UNIT-

Introduction to Architectural Drawing: Lines: Using different pencils (H, HB, 2B, 3B….) draw lines to understand the quality of line and other exercises to improve drafting skills Introduction, Drawing Instruments and their uses, BIS conventions, Drawing sheets, Lettering styles, Hierarchy,

Dimensioning, Scales: reading the scale and using it to draw rectangles and squares of various dimensions. (Reduction and enlargement), Architectural scales,

UNIT-II –

Introduction of plane geometry and polyhedral structures, Construction: Regular polygons and its methods, tangents, ellipse, parabola, Oval, hyperbola, Types of arches

Loci, cycloids, trochoids, epi and hypocycloids, spirals and involutes, helix

UNIT-III –

Orthographic Projection: Projection – Orthographic Projection – Planes of Projection – Four quadrants – First-angle projection (to be adopted), Reference line – Conventions employed. Third-angle projection (Only information)

Projection of points: Points in different quadrants.

Projection of Straight Lines: Parallel to one or both planes – Contained by one or both planes – Perpendicular to one plane and parallel to other plane – Inclined to one plane and parallel to the other – Inclined to both planes.

Projection of Planes: Types of Planes – Perpendicular Planes – Oblique Planes – Projection of Planes **-** Parallel to one Plane – perpendicular to both planes – perpendicular to one inclines to other – Oblique planes (only change of position method).

UNIT-IV -

Orthographic projection of solids; To study simple geometric solids in plan, elevation and section to enhance the 2 dimensional and 3 dimension perceptions, Three dimensional representations of simple solid forms;

Sections of Solids: Section Planes – Sections – True Shape of Section – Sections of Prisms – Sections of Pyramids – Sections of Cylinders – Section of Cones.

COURSE OUTCOMES:

The students shall be able to

- Explore the scales and basic drawing & drafting skills
- Handle techniques of orthographic projection.
- Represent design projects in three dimensional forms.
- Employ graphical presentation skills for effective communication in design.

REFERENCES:

1. N.D.Bhat "Engineering Drawings"
2. I.H.Morris. "Geometrical Drawing for art students"
3. K.R.Gopalkrishna "Engineering Drawings (vol-1&2)"
4. "Architectural Graphics" by C.Leslie Martin
5. "Architectural Graphics" by Francis D K Ching

Course Title	HISTORY OF ARCHITECTURE I		
Course Code	BR17AR104	IA Marks	25+25
L:T:P	1:0:1	Exam Hours	SEE
Contact Hours per Week	1:0:2	Exam Marks	50

COURSE OBJECTIVES:

- Inform about the development of architecture in the Ancient Western World and the cultural and contextual determinants that produced that architecture.
- Describe architecture as evolving within specific cultural contexts including aspects of politics, society, religion and climate.
- Explain the development of architectural form with reference to Technology, Style and Character in the prehistoric world and in Ancient Egypt, West Asia, Greece and Rome.

COURSE CONTENTS:

UNIT- I

PREHISTORIC AGE & ANCIENT RIVER VALLEY CIVILIZATIONS: MESOPOTAMIA

Introducing concepts of culture and civilization – Paleolithic and Neolithic Culture – art forms and evolution of shelter – megaliths – agricultural revolution and its impact on culture and civilization.

West Asian Architecture – Sumerian, Babylonian, Assyrian and Persian culture – evolution of city-states and their character and architecture – evolution of the ziggurat and palaces.

UNIT-II -

EGYPTIAN and INDUSVALLEY CIVILIZATION

Landscape and culture of Ancient Egypt – history – religious and funerary beliefs and practices – monumentality – tomb architecture: evolution of the pyramid, Mastaba, palaces, temple architecture: mortuary temples. Indus valley – Harappa, Mohenjo-Daro, Great bath, Granary& town planning

UNIT-III-

CLASSICAL PERIOD: GREECE

Landscape and culture of Greece – Greek culture – Hellenic and Hellenistic cultures – Greek character – Greek city planning – architecture in classic periods; Public Buildings: Greek temple: evolution and classification.Greek Orders in architecture: Doric, lonic, Corinthian

UNIT-IV-

CLASSICAL PERIOD: ROME

Roman history: Republic and Empire – Roman religion and the Roman temple – Roman character – lifestyle – Roman urban planning – art and architecture as imperial propaganda: forums and basilicas– structural forms, materials and techniques of construction – Roman orders in architecture. Imperial Forums, Enclosure and manipulation of space: Pantheon – Public Structures.

COURSE OUTCOMES:

The students shall be able to

- Describe and analyze historical buildings
- Apply Influences of culture and climate of the period on buildings
- Illustrate construction techniques and architectural characteristics of the period

REFERENCES:

- Sir Banister Fletcher, "A History of Architecture", CBS Publications (Indian Edition),1999.
- Spiro Kostof, "A History of Architecture: Setting and Rituals, Oxford University Press, London, 1985.
- Leland M Roth; "Understanding Architecture: Its Elements, History and Meaning"; Craftsman House; 1994.
- Pier Luigi Nervi, General Editor, "History of World Architecture – Series", Harry N. Abrams, Inc. Pub., New York, 1972.
- Lloyd S. and Muller H.W., "History of World Architecture – Series", Faber and Faber Ltd., London, 1986.
- Gosta, E. Samdstrp, "Man the Builder", Mc.Graw Hill Book Company, New York, 1970.
- Webb and Schaeffer; "Western Civilisation", Volume I; VNR: NY: 1962.
- Vincent Scully, "Architecture – The Natural and the Manmade", Harper Collins Pub: 1991.

Course Title	**FINE ARTS AND APPLIED ARTS I**		
Course Code	**BR17AR105**	**IA Marks**	**25+25**
L:T:P	**0:0:2 = 2**	**Exam Hours**	**SEE (Term Work)**
Contact Hours per Week	**0:0:4 = 4**	**Exam Marks**	**50**

COURSE OBJECTIVES:

Train the students with free hand movements for sketching. Importance of Strokes and techniques in different mediums.

Teaching rendering techniques to represent built forms, foliage, humans, cars and common objects for enabling in design presentation.

Free and individualistic interpretation without structure.

COURSE CONTENTS:

UNIT-I -

Still life Shading: objects with different tones, like light and dark, shading with different types of material, e.g.: plastic, steel etc.

Sketching in pencil and pastel colors,

UNIT-II

Other mediums- Water colors, acrylics, Oils, mixed media etc.

Outdoor sketching exercises to understand scale, mass and voids, openings and massing. Foreground, middle ground and Background. Exploring imaginative compositions inspired by visual cues in canvas using oils or acrylics.

UNIT- III

Pen and Ink rendering, watercolor washes and other techniques for representing Built forms, Foliage, trees, landscape, and common objects.

Learning the sketches of artists; humans, street sketches, heritage buildings, modern buildings.

Colour pencils, crayons, water colours, oil pastels and mixed media. Colour schemes in rendering.

UNIT-IV

Basics of freehand indoor and outdoor perspective drawings: Interior- One-Point Perspective, Exterior –

Two Point Perspective. Rendering the plan, Elevation combining skills of all mediums and techniques.

COURSE OUTCOMES:
The students will be able to

- Use the rendering techniques learnt for design presentations.
- Use different types of rendering methods.
- Visualize the built form three dimensionally

REFERENCES:

1	Gill, Rober W	Rendering with Pen + Ink	Thames & Hudson
2	Ching, Franicis D K	Architectural Graphics	John Wiley
3	Rodgers, Nigel	The Rise & Fall of Ancient Rome	Anness
4	Ching, Franicis D K	A Visual Dictionary of Architecture	Van Nostrand Reinhold
5	Thomary Edith	A History of Fine Arts in India and West	Orient Longman

Course Title	**STRUCTURES - I**		
Course Code	**BR17AR106**	**IA Marks**	**25+25**
L:T:P	**2:0:1 = 3**	**Exam Hours**	**SEE**
Contact Hours per Week	**2:0:2 = 4**	**Exam Marks**	**50**

COURSE OBJECTIVES:

- Explain Basic Structural Elements and understanding of their behavior
- Explain the properties & usage of structural Materials
- Illustrate the various force system
- Describe types of Loads & Supports systems

COURSE CONTENTS:

UNIT-I

Evolution of Structures: Historical perspective and definition of structure as a device for channeling loads that result from the use or presence of the building in relation to ground. Built structure, components, forces, loads, types, different roofing system

Building system: Structural and enclosure system, Building codes, Types of construction, Loads on building (brief), Structural forces, Structural equilibrium, Columns, beams

Structural Materials: Mechanical properties of Structural materials: wood, masonry, steel, concrete, fabric; energy use and rupture length. Advantages and disadvantages of Structural Materials and choice of Structural Material for domestic buildings, Industrial buildings, Tall buildings and Long Span buildings.

Experiment with Structures: Boiled egg, Paper structure to withstand load, Bridge using sticks, simple examples for structural understanding

UNIT-II

Loads on Structures: Dead load (DL), live load (LL), static, dynamic, impact, and thermal loads.
Principle of transmissibility of forces: Understanding load flow by tributary load and load path (slab, beam, and girder) and vertical members (post, wall, and footing); load path. Force and stress
Equilibrium of Forces: Force, Reaction, Moment and Principle of Support conditions and their

significance in resistance to forces and to maintain equilibrium.

UNIT-III

Basic principles of mechanics: Tension, compression, shear, bending, torsion; symbols and notations; **Stress/strain relations (Hooke's Law):** Modulus of Elasticity, linear and non-linear materials, elastic, plastic, and elastic-plastic materials; Poisson's Ratio; Thermal stress and strain.

Graphic vector analysis: Resultant and equilibrant of coplanar, concurrent and non-concurrent force systems. Parallelogram, force polygon, resultant, equilibrant, components; numeric method

UNIT-IV

Truss: Truss concept of triangulation, common truss configurations.

Truss loads and reactions: For a given configuration of the trusses and center to center spacing, calculations of the dead weight of the truss and the dead weight of the roof cover and support reaction loads.

COURSE OUTCOMES:

The students shall be able to

- Explore the basics of Structural Elements and their behavior
- Identify properties & usage of structural Materials
- Explore the various force system
- Understand and identify Loads & Supports systems

REFERENCES:

1. STRUCTURES - Martin Bechthold, Daniel L Schodek, PHI Learning Private limited
2. Structures in Architecture, the building of buildings, Mario Salvadori
3. Building Construction Hand book, Roy Chudley and Roger Greeno

Structural Engineering for Architects, Dongre A P

Course Title	COMMUNICATION SKILLS		
Course Code	BR17AR107	IA Marks	25+25
L:T:P	3:0:0 = 3	Exam Hours	SEE
Contact Hours per Week	3:0:0 = 3	Exam Marks	50

COURSE OBJECTIVES:

- Introduce the basics of communication in English through written and spoken activities
- Explain to the learner to use the language in a proficient way
- Develop the learner’s communicative competence in English

COURSE CONTENTS:

UNIT-I

Grammar - Parts of speech, Identifying errors in sentences, Writing- Reading skills – Reading Comprehension, Architecture related articles from various magazines, Job application letter, preparing a resume / curriculum vitae,

UNIT-II

Understanding Communication Process; Introduction to communication and its process, Forms of communication, Levels of communication, Barriers to communication, Nonverbal communication; Basics of letter writing, E-mail letters,

UNIT-III

Writing skills - Paragraph writing, Précis writing, Usage of Phrasal verbs and Idioms using right choiceof words in a given context, usage of tenses, Importance of Body Language,

UNIT IV

Grammar - words commonly confused and misused, Expansion of ideas, Technical writing –concept Theme about design, Appreciation of a project, case study conclusion, Literature & Architecture etc, Effective Presentation and Group discussion skills;

COURSE OUTCOMES:

The student would be able to

- Exhibit proficiency in the English language,
- Communicate effectively and thereby enhance their employability.
- Express his ideas effectively through write ups

REFERENCES:

1	Taylor, Grant	English Conversation Practice	TMH
2	Mudambadithaya, G S	Communicative English Made Easy	Sapna
3	Thomson, A J & Martinet, A V	A Practical English Grammer	Oxford

SECOND SEMESTER

Course Title	**ARCHITECTURAL DESIGN - II**		
Course Code	BR17AR201	IA Marks	25+25
L:T:P	4:0:2 = 6	Exam Hours	Viva voce
Contact Hours per Week	4:0:4 = 8	Exam Marks	50

Studio Theme: Form Function Symbiosis

COURSE OBJECTIVES:

- To explore relationship between form and function
- To understand abstraction of form and generation of concept for an architectural design
- To Translate behavioral needs into an architectural program
- To develop sensitivity towards site and surroundings.

COURSE CONTENTS:

UNIT-I

Basics of form and function symbiosis. Studio exercises linked to form exploration in architectural design. Introduction to Design of simple uni-functional spaces. Introduction to the problem, Requirement finalization, concept development.

Exercises relating personal experiences to behavioral needs and translating them into architectural program requirements

UNIT-II

Design development. Double line plans, and 3D visualization along with models.

UNIT-III

Introduction to design of a simple building within immediate observable environment. Basic introduction to the design of human habitat, its components and space standards.
Explore the relationship between human feelings and architectural form – observe aspects of design like aesthetics, light, circulation, form guidelines for design;
Case studies, case study documentation and presentation,
Basics of site analysis and area program generation based on case study analysis
Zoning, bubble diagram, proximity analysis
Concept, Single line plan, study models

UNIT-IV
Double line plans, 3D visualization, Roof plan, roofing, massing, elevations, sections, site plan, application of rendering and presentation technique to all drawings.

COURSE OUTCOMES:
The students are able to
- Explore the relationship between space & Activities.
- Apply different materials in design
- Convert 2 dimensional drawings to 3 dimensional drawings and vice versa
- Improve their visual observation skill and express ideas through study models
- Apply anthropometry in design

REFERENCES:

1. Wucius Wong "Principles of two-dimensional designs"
2. Francis D.K.Ching "Architecture-form space and order".
3. Robertson Howard "The principles of architecture composition"
4. Leon BaptistaAlberti "The Ten Books of Architecture"
5. John Hanock "Time Saver Standards for Architectural Design Data"
6. Ramsay and Sleeper "Architectural Graphic Standards"

Course Title	**BUILDING CONSTRUCTION & MATERIALS - II**		
Course Code	**BR17AR202**	**IA Marks**	**25+25**
L:T:P	**2:0:2 = 4**	**Exam Hours**	**SEE**
Contact Hours per Week	**2:0:4 = 6**	**Exam Marks**	**50**

COURSE OBJECTIVES:
- Introduce wood / timber in construction
- Introduce tools used in carpentry, joinery
- Explain principles of construction in wood and its properties; Door, window, roofing using wood

COURSE CONTENTS:

UNIT-I
Doors: Introduction to doors and frames, parts of door, types of doors, detail study of panel doors with glass, flush doors, louvered door, sketch of steel door frames.
Classification of carpentry joints.
Materials- Timber – growth of trees, felling, varieties, defects and decay, seasoning and prevention, fire proofing, properties, strength and uses of manufactured wood products, wood and its products for sound and thermal insulation. Protective measures for timber before usage in building.
Other factors: cost factor, available in Karnataka (locally) visit to the timber yard (Industry), natural form,

and manufactured form

UNIT-II
Windows: Introduction to wooden windows – detail study of simple casement windows, wooden shutters, glazed wooden shutters, fanlights, top hung ventilators, fixed window, horizontal and vertical pivot windows, and louvered windows, double glazing, fixed and sash windows. Sketch of steel windows and method of fixing.

UNIT-III–24 Hrs
Basic Wall Systems II –Different types of Concrete walling, Basics of Partition walls in Timber and aluminum, Glass. To know architectural representation of these walling systems.

UNIT-IV–24 Hrs
Timber Staircase: Introduction to staircase. Technical terms, requirements of good staircase, types of steps, classification of staircase, design of staircase. Components and fixing details of Timber staircases. Steel staircases
Material Study: Concrete and Glass
Site / field visit: Regular site visits to construction sites and buildings to understand the practical implication of classroom learning.
Visits to Timber yard to understand storage, cutting process etc.
2 to 4 plate from each unit ,sketch books and material portfolio to be prepared

COURSE OUTCOMES:

The students will be able to
- Draft and read architectural drawings using architectural conventions.
- Identify the components of a building such as doors, windows, wall system, staircase and their construction methods.
- Employ appropriate building materials based on the properties, behavior and applications and identifying the finishes for usage in building.

REFERENCES:
1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
4. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

Course Title	**ARCHITECTURAL GRAPHICS - II**		
Course Code	**BR17AR203**	**IA Marks**	**25+25**
L:T:P	**3:0:1 = 4**	**Exam Hours**	**SEE**
Contact Hours per Week	**3:0:2 = 5**	**Exam Marks**	**50**

COURSE OBJECTIVES:
- To develop skills for technical representation of architectural designs
- Demonstrate how to produce 2D and 3D drawings
- Discuss how to comprehend industry specific drawings
- Explain how to produce simple clear and illustrative drawings as per existing standards

COURSE CONTENTS:
UNIT-I

Study of solids and three dimensional representations of simple forms; Isometric, Axonometric, Exploded

Views, Purpose & importance, comparisons

UNIT-II

Developments of Surfaces; Developments of Lateral Surfaces of Solids - Polyhedra (Cube – Tetrahedron - Prisms and Pyramids) – Solids of revolution (Cone and Cylinder) and their Frustums, Models to be prepared for better understanding

UNIT-III

Study of complex forms, 3D composition in Isometric, Axonometric and Exploded Views, Usage in details, built forms etc

Isometric Projection: Isometric axes - Lines and Planes – Isometric Scale – Isometric Projection of Planes – Prisms – Pyramids – Cylinders – Cones – Spheres - Hemi-Spheres - frustums - Combination of Solids (Maximum Three). Conversion of Orthographic Drawing to Isometric View / Pictorial Drawing of a simple built form, 3D composition.

UNIT-IV

Application of graphics in Drawings: Architectural drawing (building plans, elevations, sections), Views of joints, furniture etc (carpentry joint, brick bonds, cabinet, chajjaetc); Details in isometric;

COURSE OUTCOMES:

The students are able to

- Explore their skills in technical representation of architectural designs
- Prepare 2D and 3D drawings & visualize them
- Produce clear architectural drawings as per existing standards

REFERENCES:

1. N.D. Bhat. “Engineering Drawings”
2. I H. Morris “Geometrical Drawing for art students”
3. K.R. Gopalkrishna “Engineering Drawings” (vol- 1&2)
4. Rendering with pen & ink” by Robert Gill.
5. Drawing and Perceiving by Douglas Cooper
6. “Perspective” by S.H.Mullik

Course Title	**HISTORY OF ARCHITECTURE - II**		
Course Code	**BR17AR204**	**IA Marks**	**25+25**
L:T:P	**1:0:1 = 2**	**Exam Hours**	**SEE**
Contact Hours per Week	**1:0:2 = 3**	**Exam Marks**	**50**

COURSE OBJECTIVES:

- Explain evolution of Church architecture within specific cultural contexts including aspects of society, religion, politics and climate
- Introduce the development of architectural form with reference to technology, style and character in the Western World through the evolution of the church from early Christian times up to the Renaissance period.

COURSE CONTENTS:

UNIT-I–EARLY CHRISTIAN &BYZANTINE -

Architectural Character and various influences over Early Christian architecture in Italy

Church planning – Basilican concept: St. Peters Rome (old)

Tombs- tomb of Gala Placidia, Baptisteries – Baptistery of Constantine
Architectural Character and various influences over architecture in Byzantine
Centralized plan concept: S. Hagia Sophia, Constantinople; St. Marks, Venice

UNIT-II–EARLY MEDIEVAL PERIOD -
Introduction to Romanesque architecture, Architectural character, influences etc
Architectural Character & building techniques of Romanesque architecture of
Italian Romanesque churches, development of vaulting, building techniques, Pisa Group
French Romanesque architecture with examples such as Abbey aux Hommes
British Romanesque architecture with examples such as Peterborough cathedral

UNIT-III - LATE MEDIEVAL PERIOD -
Introduction to Gothic Architecture, influences and Architectural Character
Development of Gothic architecture Church plan, structural developments, building techniques with examples –
France – Gothic Character with examples such as Cathedral of Notre Dame
England - Gothic Character with examples such as Salisbury Cathedral
Italy - Gothic Character with examples such as Milan cathedral

UNIT-IV - RENAISSANCE AND BAROQUE –
Introduction to Renaissance architecture, Renaissance architectural character and building technique Italy – Contribution of Brunelleschi, Bramante and Michelangelo with examples; Palazzos; St.Peter's Rome
France –Renaissance architectural character with examples such as Soufflot's Pantheon Paris
England – Renaissance architectural character with examples such as Christopher Wren's St. Paul's Cathedral
Brief Introduction to Baroque & Rococo Architecture

COURSE OUTCOMES:

The students shall be able to
- Describe and analyze historical buildings
- Apply Influences of culture and climate of the period on buildings
- Illustrate construction techniques and architectural characteristics of the period

REFERENCES:

1	Toman, Rolf	History of Architecture From Classic to Contemporary	Parragon
2	Sir Banister Fletcher	A History of Architecture	CBS Publishers
3	Ching, Franicis D K	A Visual Dictionary of Architecture	Van Nostrand Reinhold
3	Rodgers, Nigel	The Rise & Fall of Ancient Rome	Anness
5	Thomary Edith	A History of Fine Arts in India and West	Orient Longman
6	Yatin Pandya	Elements of Space Making	

Course Title	THEORY OF DESIGN - I		
Course Code	BR17AR205	IA Marks	25+25
L:T:P	3:0:0 = 3	Exam Hours	SEE
Contact Hours per Week	3:0:0 = 3	Exam Marks	50

COURSE OBJECTIVES:

- Introduce theory of architecture
- Describe how design compositions are made
- Analyze, criticize and appreciate composition based on principles
- Describe various aspects of aesthetics in design

COURSE CONTENTS:

UNIT-I

Introduction to Theory of Architecture, grammar of design concept of elements such as Point, Line, Plane & Volume, Organizing principles in design – Axis, Symmetry, Asymmetry, Datum, Linear arrangement, Radial arrangement, Concentric Arrangement

UNIT-II

Principles of architectural composition - Unity, Duality, Rhythm, repetition, Scale, Theory of Proportions, Material, Structural and Manufactured Proportions, Proportioning system- Golden Section, Classical Orders, Modular, Anthropometry

UNIT-III

Principles of architectural composition- Contrast, Restraint, Repose, Punctuation/Definition, Strength, Accentuation, Gradation, Hierarchy, Balance, Harmony, Vitality, Dynamism, Ornamentation, Character/Style in architecture

UNIT-IV

Spatial organization –Central, Linear, radial, clustered, Grid organizations
Building Materials: Stone, Brick, concrete, Timber. Iron& steel, Glass
Generation of forms- Pragmatic, analogic, Canonic and Iconic, Properties of form, Transformation of form

COURSE OUTCOMES:

The students are able to

- Explore design compositions
- Apply design principles to analyze, criticize and appreciate composition
- Explore aesthetics in design, application of materials and generation of forms

REFERENCES:

1. Francis D.K. Ching "Architecture Form, Space and order"
2. Yatin Pandya "Elements of Space Making"
3. Aesthetics a text book- Yuri Borev
4. "Design fundamentals in Architecture" by V S Parmar
5. "Details – Architects Art" by Sally Wood bridge
6. "World's greatest Architecture, past and present" by D M Field

Course Title	STRUCTURES-II

Course Code	**BR17AR206**	**IA Marks**	**25+25**

L:T:P	**2:0:1 = 3**	**Exam Hours**	**SEE**
Contact Hours per Week	**2:0:2 = 4**	**Exam Marks**	**50**

COURSE OBJECTIVES:

- Introduce the principle of loads
- Introduce structural Materials
- Explain the structural behavior of beams & columns

COURSE CONTENTS:

UNIT-I

Geometric properties: Centroid, Centroid axes and Moments of Inertia for regular sections by Parallel Axis Theorem.

Beams and support reactions: Beams and supporting conditions - Types of supports–Implications for computational and structural performance.

Bending and Shear force in beams: Method of balancing moments and free-body diagrams.

UNIT-II

Bending Moment and Shear Force Diagrams: Concept of Shear force and Bending Moment diagrams. BMDand SFD for simple beams subjected to loads.
BMD and SFD for intermediate beams 2span, 3span and 4span beams (bending moment diagrams to be provided).
Bending and Shear Stress in beams: Theory of simple bending - Concept of bending and shear stress distribution at a cross section due to bending moment and shear for Rectangular, I and T sections.

UNIT-III

General formula: Moment of Inertia, Section Modulus, Bending and Shear Stress.
Deflection: Determination of deflection for simply supported, fixed, continuous and Cantilever beams subjected to loads using standard formulas.

UNIT-IV

Columns and Struts: Introduction to Short and long columns.
Theory of Columns: Buckling; effective length, critical load, slenderness ratio; Euler formula; "Kern" and ruleof inner third.
Steel Columns: Axial stress and combined axial and bending stress design and analysis of steel columns.

RCC columns: Definition of short column as per IS 456 and design of short RCC columns (composite action,load taken by steel and load taken by concrete respectively).
Form work: Different types

COURSE OUTCOMES:

The students would have developed an understanding of

- The principle of loads
- Behavior of structural Materials
- The structural behavior of beams & columns

REFERENCES:

1. STRUCTURES - Martin Bechthold, Daniel L Schodek, and PHI Learning Private limited, Sixth Edition
2. Structure in Architecture, the building of buildings, by Mario Salvadori
3. Structure and Design, by G. G. Schierle
4. Strength of Materials – R K Bansal, Laxmi Publications, New Delhi, 3rd ed
5. Applied Mechanics & Strength of Materials – I B Prasad

Course Title	**FINE ARTS / APPLIED ARTS - II**		
Course Code	**BR17AR207**	**IA Marks**	**25+25**
Lecture: Tutorial: Practical (L:T:P)	**0:0:2 = 2**	**Exam Hours**	**Viva Voce**
Contact Hours per Week	**0:0:4 = 4**	**Exam Marks**	**50**

COURSE OBJECTIVES:

- Give training in basic skills and creative use of various materials for model making
- Learn to make architectural models to scale.

COURSE CONTENTS:

UNIT-I

Introduction to different materials, Surface development using paper, making basic shapes out of different materials to explore the nature & texture of the material, Choose from Plaster of Paris, cement, wire mesh etc.

UNIT-II

Geometrical shapes in varied materials. Choose from materials such as clay,Pottery and papier Mache etc.

UNIT-III

Exercises involving creating small study models for architectural projects, understanding of scale, material usage for various elements such as building components (walls/ openings /staircase/ roofing), furniture etc. Usage of conventional model making materials such as mount board, paper, foam board, balsa wood etc.

UNIT-IV

Exercises involving creating large scale study models for architectural projects including buildings, site detailing on model, landscape elements, street furniture etc. Color scheme and textures for large scale architectural models. Innovative use of various model making materials to achieve the desired texture and form.

COURSE OUTCOMES:

The students can

- Explore the different types of materials and its feasibility in model making.
- Explore the use of materials
- Prepare large scale models in groups

REFERENCES:

1	Gill, Rober W	Rendering with Pen + Ink	Thames & Hudson
2	Ching, Franicis D K	Architectural Graphics	John Wiley
4	Ching, Franicis D K	A Visual Dictionary of Architecture	Van Nostrand Reinhold

Course Title	**ART APPRECIATION AND PHOTOGRAPHY**		
Course Code	**BR17AR208**	**IA Marks**	**25+25**
Lecture: Tutorial: Practical (L:T:P)	**2:0:0 = 2**	**Exam Hours**	**Term Work**
Contact Hours per Week	**2:0:0 = 2**	**Exam Marks**	**50**

COURSE OBJECTIVES:

Introduce the various types of art, the role of an art; distinguish between art, craft and architecture.
Describe the importance and relevance of fine arts, commercial arts, industrial arts etc in architecture.

COURSE CONTENTS:

UNIT-I

Introduction to art; Definition of art; Mediums used in Art, purpose and function, understanding 2D, 3D, 4D Art Fundamentals of interpretation of a work of Art: form & content; analysis of painting – line, shape, color, texture, space& mass, composition, scale etc

UNIT-II

Art Criticism: Types, Criticism of works of art. Spatial art: Sculpture, types, different types of Installations & its role in society, Types of art - Commercial arts, abstract art, pop art, Industrial arts, digital art Group exercises: Installation /Sculpture

UNIT-III

Pre-Historic to Baroque – Over view of changes and adaptations in Art.
Movements & isms in art, impact of each over Architecture. Works of European Masters.
Performing / Temporal Arts: Drama, Music, Film, Dance.

UNIT-IV

Visual Arts: Indian Artists – Different schools and their influences, Indian Folk art forms, influence of the vernacular in Modern architectural spaces.
Photography - Techniques, Types, Pictorialism, Straight photography; Practical application
Literature and Architecture.
Group Exercises: Music, Dance, Literature and Architecture coming together as a production.
Photography workshops to understand Indoor and outdoor photography.

COURSE OUTCOMES: The students can:

- Interpret the role of art, to distinguish between art, craft and architecture.
- Differentiate the different types of art and understand their relevance.
- Develop a sense of criticism.
- State the historical development of art.
- Relate architecture to the allied fields of art.

REFERENCES:

1	Gill, Rober W	Rendering with Pen + Ink	Thames & Hudson
2	Ching, Franicis D K	Architectural Graphics	John Wiley
3	Rodgers, Nigel	The Rise & Fall of Ancient Rome	Anness

4	Ching, Franicis D K	A Visual Dictionary of Architecture	Van Nostrand Reinhold
5	Rao Pratap, M	Architectural Design Theory and design	Standard Publishers
6	Pandya, Yatin	Concepts of Space Traditional Indian Architecture	Mapin
7	Edith Thomory	A History of fine arts in India and the west	Orient Longman
8	http://stuffyoulook.blogspot.in/2013/10/indian-state-paintings-and-painters.html		
9	http://www.slideshare.net/johnricard/introduction-to-art-history		
10	http://www.slideshare.net/sutherlime/art-criticism-2-ppt		
11	http://www.slideshare.net/diojoeyrichard/art-styles-15846607		
12	http://www.slideshare.net/MahetaShivang/types-of-art		

1. ARCHITECTURAL DESIGN-III

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR301	**Architectural Design III**	HC	0	4	2	6	10

COURSE OBJECTIVES

- Describe relation between site, building and user requirements.
- Indicate horizontal and vertical circulation patterns.
- Demonstrate Role of fenestrations in building design
- Emphasize the role of interior volumes, light and movement

Theme of the studio: Design of a simple building for public activity.

COURSE CONTENTS:

UNIT I

Introduction to the problem, Case studies, case study documentation and presentation, Requirement finalization, Site study, site analysis, concept development, zoning and development of floor plans based on function and concept

UNIT II

Development of Double line plans, 3D visualization using study models, Roof plan, roofing, massing, elevations, sections, site plan,

UNIT III

Detailing of any building space with emphasis on openings, structural framework, materials etc.

UNIT IV

Application of rendering and presentation technique to all drawings, 3d models.

COURSE OUTCOMES

1. Infer the design philosophy for non-personal use spaces.
2. Extend the knowledge gained in Building construction and Structures to Architectural design project.
3. Express graphically manual presentation techniques

REFERENCES:

1. Neufert, Ernst architect's data. Crosby Lock Wood and Sons
2. Time Saver Standards for Architectural Design Data. McGraw Hill.

2. BUILDING CONSTRUCTION & MATERIALS-III

Course Code	Course Title	pe	L	P	D	Total	Contact Hrs.
BR17AR302	**Building Construction Materials III**	HC	2	2	0	4	6

COURSE OBJECTIVES:
• Explain different types of window openings like dormer, bay windows
• Introduce Concrete slabs
• Explain the new types of concrete used in industry
• Introduce the new damp proof techniques used to protect the building from weather

COURSE CONTENTS:

UNIT I
Medium and large size openings: collapsible gate, rolling shutter.
Plastics as a building material, types, properties and uses of plastics such as polycarbonates, acrylics, PVC polymer films, and fiber reinforced plastic. Application and details.

UNIT 2
Doors: Sliding door, folding door, sliding and folding door, sliding window (wooden and aluminum)

Windows: In advanced materials like Aluminium, UPVC, frame sections and beading details,

Plastering: Preparation, types, finishes, tools used, pointing, white washing and color washing
UNIT 3
Floor finishes - Different Types of Roof / Floor: Brick jack arch, madras terrace. Various floors finishes like wooden flooring, stone flooring, tile flooring and skirting- laying, fixing and finishes
Paints: Types, manufacture, use. Paints for interiors and exterior, oil bound distemper, varnishes, plastic emulsion etc., and their uses

UNIT 4:

Skylights: Study and details of different types of skylights.
Weather and water proofing elements: Water and weather proofing of flat terraces, sloping roofs, in different materials, finishes in bathrooms, basics of water proofing, bitumen felts method.
Water proofing compounds: Flexible, Semi-Rigid, Rigid and Grout materials –market survey.

Site / field visit: Regular site visits to construction sites and buildings in order to understand the practical implication of theoretical inputs.

COURSE OUTCOME: Students will be able to

1. Express through drawings the different types of openings in steel, wood and other new materials
2. Describe the different types of floor finishes, laying method.
3. Associate plastics as one of the material in construction industry.
4. Elaborate on different water proofing/damp proofing materials and techniques in construction industry.

REFERENCES

1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

3. ARCHITECTURAL GRAPHICS-III

Course Code	Course Title	Type	L	P	D	Total	ContactHrs.
BR17AR303	**ARCHITECTURALGRAPHICS III**	HC	2	1	0	3	4

COURSE OBJECTIVES

- Introduce the fundamental techniques of Perspective drawings
- Enhance the visual skills
- Explain the theory behind Sciography
- Enhance the presentation skills

COURSE CONTENTS:

UNIT I

Perspective: Understanding fundamental techniques of 1- point perspective construction to enhance the student's architectural drawing skills and the visual skills, finally assisting them in appreciating built forms in their design presentations.

UNIT II

Perspective: Understanding fundamental techniques of 2- point perspective construction to enhance the student's architectural drawing skills and the visual skills, finally assisting them in appreciating built forms in their design presentation.

UNIT III

Sciography: Learning about light, shade and shadow on built forms and applying the knowledge of sciography on the design presentations to understand the undulations, depths, hierarchy of surfaces and built forms.

UNIT IV

Rendering: Developing an understanding the importance of color schemes in design presentations as well as its application on built forms to create pleasing environments.

COURSE OUTCOMES:

The students will be able to

1. Illustrate 3D visualization through perspective drawings
2. Identify the importance & need of presentation skills for effective communication in design.
3. Identify and indicate building depth in buildings through Sciography

REFERENCES:

1	Gill, Rober W	Rendering withPen&Ink	Thames & Hudson
2	Ching,FranicisD K	Architectural Graphics	John Wiley
4	Ray Smith	AnIntroductionToPerspective	Royal Academy of Arts

THEORY OF DESIGN II

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR304	**THEORY OF DESIGN II**	HC	3	0	0	3	3

COURSE OBJECTIVES:

- Introduce a broad overview of the evolution of thought and trends in architecture practice, across timeline
- To acquaint the students with architectural theory from antiquity to postmodern movement.
- To identify factors which influenced the architectural design in a particular context &Period.

COURSE CONTENTS

UNIT I

Introduction to Theory in Antiquity: Marcus Vitruvius and his multi-volumeWorkentitledDeArchitecture. Mayamata: Indian Treatise on Housing&Architecture.

Introduction to Theory in Renaissance: Choose from the theories ofLeonAlberti, Andrea Palladio

French Academic Tradition: JacquesFrancousBlondelandClaude Perrault

18th and 19th Century Theory: Choose from the Ideas of Laugier, Boullee,Ledoux, Quatramere de Quincy and GottfriedSemper

UNIT II

Modern movement: Introduction to modern movement, Modern movement masters. Modern architecture-Influence of new material and techniques, demand for new types of building, influence of technology-Chicago school, Eclectism, Art and Crafts movement, Art Nouveau

UNIT III

Modern Movement Theories across the world: Choose from the theories ofAlvarAlto,Adolf Loos, EeroSarinen, Erich Mendelsohn, Richard Neutra, OttoWagner, KenzoTange etc.

UNIT IV

Post Modern Theory: Ideas on Post-Modern Classicism by Robert Venturi andCharles Jencks.

Contribution to architectural thought: Ideas of Kenneth Frampton andChristopher Alexander

Contribution to architectural thought: Ideas of Amos Rapoport, Geoffrey Broadbent

COURSE OUTCOMES

1. Trace the trends and practices followed in architectural design across the time line
2. Explore the architectural theory from antiquity to the present.

REFERENCES:

1 Rao Pratap, M Architectural Design, Theory and design, Standard publishers

2 Pandya, Yatin Concepts of Space Traditional Indian Architecture,Mapin

3 Broadbent, Design in Architecture,

4 Lang Jon, Creating Architectural Theory

5 Ching, Franicis A Visual Dictionary of Architecture, Van Nostrand D K, Reinhold

5. STRUCTURES – III

Course Code	Course Title	Type	L	P	D	Total	ContactHrs.
BR17AR305	**STRUCTURES – III**	HC	3	0	0	3	3

COURSE OBJECTIVES:

- Explain the basics of foundation
- Describe the different types of foundations
- Discuss the structural behavior & loads on foundations.
- Explain the necessity of deep foundation
- Explain the simple design of foundation
- Acquaint students with an ability to design and proportion structural concrete members including slabs, beams, and columns.

COURSE CONTENTS:

UNIT I

Mechanics of Reinforced Concrete: Concept of Concrete as a brittle, composite material that is strong in compression and weak in tension. Structural behavior under load and the need for reinforcement.

Structural Analysis and Design to satisfy Building Codes and Standards; Introduction to National Building Code and IS456: Calculation of dead weight and live loads on structure as per IS875 (Part1&2).

Determination of the general loads to be considered in the design of the structure based on the type of occupancy specified for each area. And introduction to safety factor and design philosophy.

RCC Materials: Basic Characteristics of Concrete & Reinforcing Steel Materials including specifications and testing. Basics of mix design, water-cement ratio, strength, durability, workability requirements and formwork.

UNIT II

RCC foundation: shallow foundations– Definition, purpose, site exploration, preliminary investigation, methods, trial pits, bore holes, Bearing capacity of soil, plate load method, penetration test method, SBC based on IS code, methods to improve SBC

Types of shallow foundations – shallow foundation, spread foundation, Isolated pad foundation, grillage foundation, column footings, Raft foundation, foundation for black cotton soil, pier foundation, foundation on sloping ground, machine foundation, causes for failure of foundation, timbering of trenches, excavation for water logged sites, concrete used for foundation Design for grillage foundation, Design for foundation for a brick pillar (SK) Structuraldesign for foundation, Design loads, Design for masonry wall foundation – depth of foundation, depth of concrete bed block, width of footing

UNIT III

Deep foundation- Pile foundations. Different types of piles and applications. Types of deep foundations, pile foundations, type of pile foundations, pile driving, structural implications, Caissons, types, Shoring, types of shoring, underpinning and scaffolding, types of scaffoldings, retaining walls

UNIT IV

Concrete Structural System design: Introduction to the Project: Design of two story RCC frame office building using different Concrete Structural Systems including a framing plan, column, beam and slab arrangements and dimensions for all the different Concrete Structural systems already introduced (Indicative) & using SP 16: Design Aids for Reinforced Concrete to IS 456:1978. One way Concrete slab system: One-way concrete slab system and design of single reinforced beams

One way Concrete slab Joist System: One-way Joist System and design of singly reinforced slabs.

Reinforcement Design: Approximate calculation of Column, Beam and Slab reinforcement.

Reinforcement detailing and placement and location of the reinforcement in a concrete structure.

Note: Class work on loading calculation of each Concrete Structural System including structural system elements, slab, beam, column and footing, will be assessed during the Viva examination.

COURSE OUTCOME:

The students shall be able to

1. Explore different types of foundation
2. . Explore the fundamental principles and structural behavior of concrete buildings

3. Explore the necessity of deep foundation
4. Apply mechanics of reinforced concrete
5. Design and proportion structural concrete members including slabs, beams, and columns.

REFERENCES:

1. STRUCTURES - Martin Bechthold, Daniel L Schodek, PHI Learning Private limited
2. IS 456-2000 Plain and Reinforced Concrete - Code of Practice
3. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
4. Building Construction, Sushik Kumar, Standard Publishers Distributors,
5. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi

Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

6. ENVIRONMENT STUDIES

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR306	Environmental Studies	HC	1	1	0	2	3

COURSE OBJECTIVES

- To describe the components of environment and importance of environmental studies.
- To outline the various types of energy and natural resources.
- To summarize about environmental pollution-sources, effects and control measures of environmental pollution.
- Explain the different ways for protecting the environment.

COURSE CONTENTS:

UNIT I:

Introduction

Basic definitions, Objectives and Guiding principles of Environmental Studies in relation to architecture, Components of Environment, Structures of atmosphere, Man-Environment relationship, Impact of Technology on the environment , Environmental Protection Acts and policies - Role of Government, Legal aspects, Initiatives by Non - Governmental Organizations (NGO), Community participation and awareness -

through architectural examples

UNIT II:

Energy & Natural Resources

Energy - Different types of energy- Conventional and Non-Conventional sources of energy, alternative source of Energy used through present day examples, conservation of natural resources.

UNIT III:

Ecology & Ecosystems

Impact of human civilizations on the earth's major Ecosystem, Forests, Oceans & Atmosphere. Assessing the impacts and ways for its mitigation, Energy flow in eco-system, Land use matrix - Consumption, Carbon Footprint, Ecological Footprint

UNIT IV:

Environmental Pollution

Environmental Degradation, Pollution, Sources of Pollution, Types of Environmental Pollution, Current Environmental Global issues, Global Warming & Green Houses, Effects, Understanding of environmental pollution and its impact through case-studies.

COURSE OUTCOMES:

On completion of this course the students will be able to**:**

1. Identify the environmental conditions and protect it.
2. Explore renewable energy resources.
3. Discuss the ecological imbalances and protect it.
4. List the causes of environmental pollution.
5. Examine the implications of pollution from pollutants.

TEXT BOOKS:

1. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited
2. Ranjit Daniels R J and Jagdish Krishnaswamy, (2009), "Environmental Studies", Wiley India Private Ltd., New Delhi
3. Rajagopalan R. (2005), "Environmental Studies – From Crisis to Cure", Oxford University Press

REFERENCE BOOKS:

1. Raman Sivakumar, (2005), "Principles of Environmental Science and Engineering", Second Edition, Cengage learning, Singapore
2. Meenakshi P. (2006), "Elements of Environmental Science and Engineering", Prentice Hall of India Private Limited, New Delhi
3. Prakash S.M. (2007), "Environmental Studies", Elite Publishers, Mangalore
4. ErachBharucha (2005), "Text Book of Environmental Studies", for UGC, University Press
5. Tyler Miller Jr. G. (2006), "Environmental Science – Working with the Earth", Eleventh Edition, Thomson Brooks/Cole
6. "Text Book of Environmental and Ecology" by Dr.Pratibha Sing, Dr.Anoop Singh and

Dr.PiyushMalaviya.
7. Acme Learning Pvt. Ltd., New Delhi.

7. CONSTITUTION OF INDIA

Course Code	**Course Title**	Type	**L**	**P**	**D**	**Total**	**Contact Hrs.**
BR17AR307	**CONSTITUTION OF INDIA**	HC	2	0	0	2	2

COURSE OBJECTIVES

- Explain the constitution of India and evolution of constitutional law
- Explain the scope and extent of fundamental rights
- Describe the various amendments

COURSE CONTENTS

UNIT I
Preamble to Constitution of India – Evolution of Constitutional Law.
Indian Tricolour Flag: its features and significance.

Scope and Extent of Fundamental Rights under Part III – Details of Exercises of Rights, Limitations and Important Cases.

UNIT II
Relevance of Directive Principles of State Policy under Part IV.
Significance of Fundamental Duties under part IV (a)

UNIT III
Union Executive President, Vice-President, Prime Minister, Council of Ministers, Parliament and Supreme Court of India.

State Executive, Governor, Chief Minister, Council of Ministers, Legislature and High Courts.
Electoral Process and special provisions: Electoral process in India.

UNIT IV
Amendment procedures. 42nd, 44th, 74th, 76th, 86th and 91st Amendments. Constitutional provisions for scheduled castes and tribes. Special provisions for Women and Children and Backward Classes.
Emergency Powers.

COURSE OUTCOMES: The student shall be able to

1. State the constitution of India
2. Experience the scope of fundamental rights
3. Examine and interpret the amendments

REFERENCES:

1 Basu, Durga, Das, Introduction to the V.K Publishers, Constitution of India

2 Pylee, M V., Constitution of India, Vikas Publication, New Delhi, 2007

8. Vacation Assignment

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR308	VacationAssignment	HC	0	0	0	2	0

COURSE OBJECTIVES

To retrospect, explore and recharge creativity through beyond the classroom learning

COURSE CONTENTS

Students are encouraged to undertake a study tour in India or International pertaining to Architectural Design Studio, History, Climatology or any other course related to the upcoming semester. The trip will include documentation work that shall be intended to enhance and support classroom learning.

Outside classroom learning can also be encouraged in the form of entrepreneurship initiative and / or development of a business model related to Architecture. For eg: Development of a mobile “Application” that can benefit the public.

Summer course conducted by the University may also be taken up by students and Grades given by the faculty handling the course may be considered for the assessment.

COURSE OUTCOMES:

The student shall be able to:

1. Develop practical knowledge of the realms of architecture
2. Gain exposure and experience through travel/ summer courses etc.

9. HINDU,ISLAMIC AND COLONIAL ARCHITECTURE

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR3091	Hindu, Islamic And Colonial Architecture – South India	SC	4	0	0	4	4

COURSE OBJECTIVES

- Introduce a broad overview of the evolution of Hindu temple architecture, Islamic architecture and colonial architecture in India and surrounding countries
- To acquaint the students with knowledge of impact of religion over architecture
- To identify the factors shapingpublic building design through study of colonial architecture

COURSE CONTENTS:

UNIT I

INTRODUCTION TO BUDDHIST ARCHITECTURE IN INDIA- Forms ofworship, building typologies, symbolism; Stupas, Viharas, Chaitya halls, stambhas

EVOLUTION OF HINDU TEMPLE ARCHITECTURE

Hindu forms of worship – evolution of temple form - meaning, symbolism, ritual and social importance of temple - categories of temple - elements of temple architecture - Development of the Hindu temple form ; Characteristics and differences between Dravidian and Aryan styles, brief examples of form evolution from Gupta ,Chalukyan, Pallava, Chola periods

UNIT II

INTRODUCTION TO ISLAMIC ARCHITECTURE

Islamic Architecture -Introduction, principal parts of mosque and tomb

Early Islamic: Slave and Khalji Dynasty - Influences & Architectural Character, Study of Qutub complex-QutbMinar ,Quwwat - ul - Islam mosque, Tomb of Iltutmish, Alai Darwaza
Late Islamic: Moghul period- Influences & Architectural Character, Study of Humayun’s tomb, Tai Mahal

UNIT III

TEMPLE ARCHITECTURE - SOUTHERN INDIA

Brief history of South India - relation between Bhakti period and temple architecture - of temple towns - Dravidian Order - evolution and form of Gopuram

Rock cut productions under Pallavas: Shore temple, Mahabalipuram and Kailasanatha temple, Kanchipuram - Chola Architecture: Brihadeeswara Temple towns: Madurai, Srirangam and Kanchipuram; Hoysala architecture: BelurHalebidandSomanathpur; Vijayanagar style – monuments at Hampi

UNIT IV

PROVINCIAL STYLES & COLONIAL ARCHITECTURE

Provincial Islamic- Bijapur, Gulbarga, Hyderabad &Bidar - Influences & Architectural Character, examples – Study of Gol Gumbaz, Jami masjid and other;

Colonial architecture of South India; Choose from Bangalore, Chennai etc. Introduction to Indo Saracenic architecture, Choose from Mysore, Hyderabad etc.

COURSE OUTCOMES: The students will be able to

1. Enumerate the trends and practices followed in Hindu & Islamic Architecture of North India
2. Identify and interpret architectural styles of different periods
3. Articulate the architectural character of Colonial buildings of British period and elaborate on the style.

REFERENCES:

1. Toman, Rolf, History of Architecture From Classic to Contemporary, Parragon
2. Bhalla, A S, Royal Tombs of India 13th to 18th Century, Mapin
3. George Michel, Temple Towns of Tamil Nadu, Marg
4. Sir Bannister Fletcher, History of Architecture, Batsford, London
5. Percy Brown, Indian Architecture – Buddhist & Hindu, D B Taraporevala Sons & Co.
6. Percy Brown, Indian Architecture – Islamic period, D B Taraporevala Sons & Co.
7. Satish Grover, Islamic Architecture, CBS Publications

Course Code	Course Title		L	P	D	Total	Contact Hrs.
BR17AR3092	**Hindu,Islamicand Colonial Architecture –North India**	SC	4	0	0	4	4

COURSE OBJECTIVES

- Introduce a broad overview of the evolution of Hindu temple architecture, Islamic architecture and colonial architecture in India and surrounding countries
- To acquaint the students with knowledge of impact of religion over architecture
- To identify the factors shaping public building design through study of colonial architecture

COURSE CONTENTS:

UNIT I

INTRODUCTION TO BUDDHIST ARCHITECTURE IN INDIA- Forms of worship, building typologies, symbolism; Stupas, Viharas, Chaitya halls, Stambhas

EVOLUTION OF HINDU TEMPLE ARCHITECTURE

Hindu forms of worship – evolution of temple form - meaning, symbolism, ritual and social importance of temple - categories of temple - elements of temple architecture - Development of the Hindu temple form; Characteristics and differences between Dravidian and Aryan styles, brief examples form evolution from Gupta ,Chalukyan, Pallava, Chola periods

UNIT II

INTRODUCTION TO ISLAMIC ARCHITECTURE

Islamic Architecture -Introduction, principal parts of mosque and tomb

Early Islamic: Slave and Khalji Dynasty - Influences & Architectural Character, Study of Qutub complex-QutbMinar ,Quwwat - ul - Islam mosque, Tomb of Iltutmish, Alai Darwaza

Late Islamic: Moghul period- Influences & Architectural Character, Study of Humayun's tomb,

Taj Mahal

UNIT III

TEMPLE ARCHITECTURE -NORTHERN INDIA

Temple architecture of Gujarat, Orissa, Madhya Pradesh and Rajasthan - their salient features, Lingaraja Temple, Bhubaneswar - Sun temple, Konarak. - Somnatha temple, Gujarat, Surya kund, Modhera ,Khajuraho, Jain Temple architecture-Planning aspects, Dilwara temple, Mt. Abu , Adinatha temple at Ranakpur

UNIT IV

PROVINCIAL STYLES & COLONIAL ARCHITECTURE

Tughlaq dynasty - Influences & Architectural Character, Tomb of Ghias- ud-din Tughlaq, Khirki Masjid

Sayyed and Lodi dynasties- Influences & Architectural Character
Moghul period- Influences & Architectural Character, Fatehpursikri,
Provincial Styles: Punjab - Influences & Architectural Character, Study of
Tomb of Shah Rukn - I -Alam
Bengal- Influences& Architectural Character, Study of Eklakhi tomb and Adina Masjid,
Jaunpur - Influences & Architectural Character, Atala Masjid Sur Dynasty –Tomb
of Sher Shah Suri at Sasaram, Introduction to Colonial architecture of North India,
choose from Delhi, Mumbai, Calcutta
Introduction to Indo Sarasenic, choose from Jaipur, Jodhpur, Bikaner etc.

COURSE OUTCOMES: The students will be able to

1. Enumerate on the trends and practices followed in Hindu & Islamic Architecture of North India
2. Identify and interpret architectural styles of different periods
3. Articulate the architectural character of Colonial buildings of British period and elaborate on the style

REFERENCES:

1. Toman, Rolf, History of Architecture From Classic to Contemporary, Parragon
2. Bhalla, A S, Royal Tombs of India 13th to 18th Century, Mapin
3. George Michel, Temple Towns of Tamil Nadu, Marg
4. Sir Bannister Fletcher, History of Architecture, Batsford, London
5. Percy Brown, Indian Architecture – Buddhist & Hindu, D B Taraporevala Sons & Co.
6. Percy Brown, Indian Architecture – Islamic period, D B Taraporevala Sons & Co.
7. Satish Grover, Islamic Architecture, CBS Publications

Course Code	Course Title	Type	L	P	D	Total	Contact Hrs.
BR17AR3093	**BUDDHIST, COLONIALARCHITECTURE –S. E. ASIA**	SC	4	0	0	4	4

COURSE OBJECTIVES

- Introduce a broad overview of the evolution of Hindu temple architecture, Islamic architecture and colonial architecture in India and surrounding countries
- To acquaint the students with knowledge of impact of religion over architecture
- To identify the factors shaping public building design through study of colonial architecture

COURSE CONTENTS:

UNIT I

INTRODUCTION TO BUDDHIST ARCHITECTURE IN INDIA- Forms ofworship, building typologies, symbolism; Stupas, Viharas, Chaitya halls, stambhas

EVOLUTION OF HINDU TEMPLE ARCHITECTURE
Hindu forms of worship – evolution of temple form - meaning, symbolism, ritual and social importance of temple - categories of temple - elements of temple architecture - Development of the Hindu temple form; Characteristics and differences between Dravidian and Aryan styles, brief examples form evolution from Gupta ,Chalukyan, Pallava, Chola periods

UNIT II

INTRODUCTION TO ISLAMIC ARCHITECTURE
Islamic Architecture -Introduction, principal parts of mosque and tomb
Early Islamic: Slave and Khalji Dynasty - Influences & Architectural Character, Study of Qutub complex-QutbMinar ,Quwwat - ul - Islam mosque, Tomb of Iltutmish, Alai Darwaza

Late Islamic: Moghul period- Influences & Architectural Character, Study of Humayun's tomb,

Taj Mahal

UNIT III

BUDDHIST & HINDU ARCHITECTURE SRILANKA, INDONASIA, COMBODIA & BALI

Buddhist & Hindu architecture in Southeast Asia, influences, architectural character, features with suitable examples

UNIT IV

COLONIAL ARCHITECTURE OF SOUTH EAST ASIA

Colonial architecture of Jakarta, Kuala Lumpur, Bangkok, Colombo & Singapore with suitable examples

COURSE OUTCOMES: The students will be able to

1. Enumerate on the trends and practices followed in Hindu & Islamic Architecture of North India
2. Identify and interpret architectural styles of different periods
3. Articulate the architectural character of Colonial buildings of British period and elaborate on the style

References:

1. The Architectural Heritage of Srilanka, David Robson.
2. The Spirit of Indian Architecture, D.K. Bulbar
3. A Concise history of Modern Architecture in India-Jon Lang.
4. Modern architecture since 1990, William IR Cu

DETAILED SYLLABUS FOR IV SEMESTER

1. ARCHITECTURAL DESIGN-IV

Course Code	Course Title	Type	L	P	D		Total	Contact Hrs.
BR17AR401	**Architectural Design IV**	HC	0	4	2		6	10

COURSE OBJECTIVES

- To introduce the students to importance of vernacular architecture in India
- To explore form development based on site, climate and context.
- To explain how architectural design can foster better interaction and activity in the public realm.

COURSE CONTENTS
Studio Theme: Site and context

UNIT I:

Documentation study of vernacular architecture; Formulation of Design proposals based on documentation study
UNIT II:

Design of a building for commercial/retail use, Introduction to urban regulatory controls and barrier free design, Case studies, case study
documentation and presentation, Requirement finalization, Site study, site analysis, concept development, zoning
UNIT III:

Design development, relating the system of horizontal and vertical circulation, Resolution of structural system, open spaces and parking design,

UNIT IV:

Double line plans, 3D visualization, Roof plan, roofing, massing, elevations, sections, site plan, application of rendering and presentation technique in 2D and 3-D format.

COURSE OUTCOMES: The students will be able to

1. Acquire knowledge on Local vernacular techniques and holistic view on rural settlements.
2. Associate the Impact of Climate, Culture, Occupation and affordability on Vernacular Architecture.
3. Explore design solutions for an urban context
4. Distinguish between designing for a rural and Urban context

REFERENCES:

1. Neufert, Ernst architect's data. Crosby Lock Wood and Sons

2. Time Saver Standards for Architectural Design Data. McGraw Hill.

3. BUILDING CONSTRUCTION & MATERIALS-IV

Course Code	Course Title	Type	L	P	D	Total Credits	Contact hours
BR17AR402	**Building construction & materials- IV**	HC	2	2	0	4	6

COURSE OBJECTIVES:

- Introduce the various metals and alloys used in building construction such as steel, stainless steel
- Introduction to various types of trusses.
- Introduce the construction of staircase with steel folded plate

COURSE CONTENTS:

UNIT I:
Steel trusses: Introduction to steel sections, welding and riveting. Buildings with small, medium span trusses, placing of trusses in key plan, typical sectional elevation of truss (tube and angle), details at ridge, eave, purlin fixing etc. Roof covering with GI sheets and other materials.
Material study: Metals and Alloys:
Properties, sustainable design character Architectural usage or application in construction industry. Galvanizing and chromium plating process.

UNIT II
Structural behavior of Large Span Steel trusses, lattice girder, tubular trusses and north light glazing.

UNIT III
Pre Engineered Buildings, Assembling process of Pre Engineered Structures, Advantages & disadvantages of PEB's castellated beams. Different types its applications, advantages & disadvantages.

UNIT IV
Composite staircases: Pre-cast wooden with steel folded plate, Fixing of Handrails in different materials like glass, aluminum, brass and fixing details of balusters and hand rails.

Material study: Materials used for composite staircase

COURSE OUTCOMES:
• Identify the various metals used in building construction such as steel, stainless steel etc.
• Elaborate on the new trends in staircase construction

REFERENCES:

1. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
2. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
3. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
4. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

4. CLIMATOLOGY-I

Course Code	Course Title		L	P	D	Total	Contact Hrs.
BR17AR403	**CLIMATOLOGY I**	HC	2	1	0	3	4

COURSE OBJECTIVES:

- Explain the influences of climate on architecture.
- Explain the different types of climate and their influence on building materials, construction techniques.
- Explain the application of Climatology in Building design

COURSE CONTENTS:

UNIT I:
Introduction to Climate: The Climate-built form interaction; some examples.
Elements of climate, measurement and representations of climatic data. Classifications and Characteristics of tropical climates, major climatic zones of India. Site Climate: Effect of landscape elements onsite/micro climate.

Thermal comfort: Thermal balance of the human body, Thermal Comfort Indices (Effective Temperature, corrected effective temperature, bioclimatic chart, tropical summer index by CBRI Rorkee). Measuring indoor air movement: Kata-thermometer, and measuring indoor radiation: Globe thermometer.

Calculation of overheated and under heated period (based on air temperature only) for locations in Climatic zones and their optimization in terms of solar heating and Passive cooling desired.

UNIT II:
Sun-path diagram: Solar geometry & design for orientation and use of solarcharts in climatic design.

Thermal performance of building elements: Effect of thermo-physicalproperties of building materials and elements on indoor thermal environment. Convection, Radiation, concept of Sol-air temperature and Solar Gain factor.

Thermal Heat gain or loss: Steady state and periodic heat flow concepts, conductivity, resistivity, diffusivity, thermal capacity time lag and 'U' value. Calculation of U value for multi-layered walls and Roof, Temperature Gradient, Inferring time lags from Graphs for walls and Roof. Construction techniquesfor improving thermal performance of walls and roofs. (Effect of density, Insulation and Cavity).

UNIT III:
Shading devices: Optimizing Design of Shading devices effective for overheatedperiods while allowing solar radiation for under heated periods for different wall orientations.

Solar control: orientation, window sizes, internal blinds and curtains, Special glasses

Natural ventilation: Functions of natural ventilation, Stack effect due tothermal force and wind velocity. Air movements around buildings, Design considerations and effects of openings and external features on internal air flow and Wind shadows.

Day Lighting: Nature of natural light, its transmission, reflection, diffusion,glare. Advantages and limitations in different climatic zones, North light, Day light factor, components of Day light devices.

UNIT IV:

Climatic Design considerations-1: Literature study of relevant traditional andcontemporary building examples.
Climatic Design considerations-2: Two Indian case studies and oneinternational for each climatic zone.

COURSE OUTCOMES: The students are able to
1. Apply knowledge of climatology in different types of climates.
2. Explore the various shading devices
3. Identify passive cooling techniques for building design
4. Customize through design, buildings for different type of climates

REFERENCES:

1 Koenigsberger, O H Others & Manual of Tropical Housing & Building Climatic Design
2 Shah M G Kale M Building Drawing With an Integrated &Patki, S Y.Approach to Built Environment
3 KumaraSwamy,N, Building Planning & Drawing

5. BUILDING SERVICES

Course Code	Course Title	Type	L	P	D	Total	ContactHrs.
BR17AR404	**Building services-I(water supply, plumbing& sanitation)**	HC	1	1	0	2	2

COURSE OBJECTIVES:

- Explain the basic aspects in environment and health.
- Acquire knowledge in water supply and sewerage system, storm water and solid waste management
- Explain how the plumbing, sanitation and sewerage systems can be used in architectural design

COURSE CONTENTS:

UNIT I:

Introduction to Environment and Health Aspects: History of Sanitation withrespect to humancivilization, Importance of Health, Hygiene Cleanliness, Water borne, Water related, Water based, Epidemic diseases, Conservancy to water carriage system, Urban and Rural sanitation.

Water Supply: Source of Water supply–Municipal, bore well, river, etc,Quantity of water for different usageslike Domestic, Hot water, Flushing, Gardening, Commercial, Industrial Applications, Assessment of requirement for different users, Quality of supply for different users as per national andinternational standards, Treatment of water for different uses, filtration, softening, disinfection, Storage and pumping – gravity system, hydro-pneumatic system, Distribution of water to fixture and fittings, schematic diagrams, Swimming pool, water bodies, Efficient usage of water, water for fire fighting

UNIT II:

Sewerage System: Assessment of sewage generated, Collection of sewage /wastewater from all sources, schematic diagram, Conveyance of sewage – gully trap, chamber, manhole, intercepting trap, grease traps, backflow preventer, Materials of construction of sewerage network – PVC, uPVC, HDPE, corrugated

PP pipes, Objective of Sewage treatment, type of treatment, aerobic, anaerobic, Ventilation of STP, Space requirements

Storm water Management: Assessment, quantification rainfall, flood controlmeasures, Drainage system– piped drains, open drains, Recharging of storm water, Harvesting of roof top water, first flush, pre-treatment, Drainage of basements, podium, paved areas, Collection, Reuse of water with in the project, reduction of the load on municipal system, landscape drainages and Rainwater harvesting, Recharging ground water table

Terrace plan with Rain water down take pipes, Sump and OHT calculation design.

UNIT III:

Plumbing: Water supply piping–hot, cold, flushing water, Piping in sunkenareas, false ceiling areas, shaft sizes, Drainage – floor traps, drains, P-trap, bottle traps, Single stack, two stack, cross venting, fixture venting, Material of construction like GI, PPR, PB, CPVC, Composite pipes, Copper, Flow controlValves – Gate valve, Globe valves, butterfly valves, Pressure Reducing valves & station, Pipe supports, hangers, fixing, plumbing of small houses.

Lay out of Water supply and Sanitation with all fixtures in Kitchen, Bath and Utility for a small Residence with Plan and Section

Special requirements: Solar Hot Water Generation, Central LPG SupplySystem, Medical Gases Supply, Storage of High Speed Diesel, Central Vacuum and Waste Collection.

UNIT IV:

Sanitary Fixtures, Fittings & Wellness: Soil appliances–Water closets, Bidet,urinals, Cisterns, Flush valve, Waste appliances – wash basin, sink, dishwasher, washing machine, Hot water system – Geysers, boilers, heat pump, Bath & water fixtures – Taps, mixers, single lever, quarter turn, bathtub, multi-jet bath, rain showers, health faucets, Wellness products : Sauna bath, steam bath, Jacuzzi, single and double stack system.

Solid Waste Management: Assessment of waste, Waste to wealth concept,

Municipal waste, garden waste, organic & inorganic, commercial waste,

Medical waste & Industrial waste, Collection, segregation, treatment, disposal,

Organic waste – Bio-methanation, Vermi-composting, Organic waste converter.

Portfolio on Solid waste management

Site Visits: Water Treatment Plants, Sewage Treatment Plants, LPG& HSD yards. High Rise Residential Building – Plumbing (water supply, drainage) Commercial Buildings like IT Campus, Hotel & Hospital for acquaintance of installation & space requirements.

COURSE OUTCOMES:

1. Elaborate on the plumbing systems used in the buildings
2. Indicate different techniques of water supply and sewerage system
3. Demonstrate knowledge of storm water and solid waste management
4. Integrate the acquired knowledge into architectural design

REFERENCES:

1. Rangwala , WaterSupply & Sanitary Engineering
2. McGhee, Terence Water Supply & Sewerage
3. Husain, S K, Text book of Water Supply & Sanitary Engineering
4. Deolalikar, S G, Plumbing Desing& Practice
5. Gahlot P S & Sharma, Building Repair and Maintenance, Management
6. Mohan, C.R& Sanjay, Design and Practical hand Book on Plumbing

8 Special IS Code: SP- 35 – 1996

9 Uniform Plumbing Code India 2012

10 Pollution Control Board Norms

STRUCTURES IV

Course Code	Course Title		L	P	D	Total	ContactHrs.
BR17AR405	**STRUCTURES IV**	HC	2	1	0	3	4

COURSE OBJECTIVES

- To give students an understanding on designing of slabs and footings
- To acquaint with various types of slabs like filler slab, waffle slab, rib slab
- To Impart Knowledge on Design of RCC Staircases, Portal frames

COURSE CONTENTS:

UNIT I:

General framing arrangement of beams, columns and slabs for a building, Design Aids for Reinforced Concrete to IS 456:1978.

Two way Concrete Floor and Roof Systems: Two-way Slab-Beam, and design of short columns

Two way Concrete Flat Plate System: Two way solid Flat Plate design, and design of isolated footings

Two way Concrete Flat Slab System: solid Flat slab design, and formwork design and detailing.

Design Review: Review of design of Column, Beam and Slab, total concrete volume, reinforcement tonnage and costing.

UNIT II

Filler slab, various materials used in filler slab. Detailing of filler slab with various materials for a particular span. Applications of filler slabs, advantages and disadvantages of filler slabs. Waffel slabs- Detailing of waffle slab, applications, advantages and disadvantages.

UNIT III

Flat slab- Detailing of waffle slab, applications, advantages and disadvantages.

Different types of Joints in a building like construction joints, expansion joints

RCC Portal frames-single bay, 2 bay, 3 pinned, 2 pinned

UNIT IV

Structural principle behind staircase, Types of RCC staircases, reinforcements and details.

COURSE OUTCOMES: The students would be able to :

1. Elaborate on Filler slab, Waffle and Flat slabs. Compute and design RCC 2 way Slab and footings for certain spans.
2. Differentiate between different techniques for staircase construction
3. Attain Knowledge ofPortal frame

REFERENCES:

1. STRUCTURES - Martin Bechthold, Daniel L Schodek, PHI Learning Private limited
2. Building Construction Hand book, Roy Chudley and Roger Greeno, Routledge, London
3. Building Construction, Sushik Kumar, Standard Publishers Distributors, New Delhi
4. Building Construction, Punmia, Ashok K Jain, &Arun K Jain, Lakxmi Publications (P) Ltd, New Delhi
5. Building Construction Illustrated, Francis D K Ching, John Wiley & Sons, Inc, New York

8. SURVEYING & LEVELING

Course Code	Course Title		L	P	D	Total	ContactHrs.
BR17AR406	**SURVEYING&LEVELING**	HC	1	1	0	2	3

COURSE OBJECTIVES:

- Describe the principles related to surveying and leveling.
- Explain methods of survey for land of medium complexity
- Explain survey plans and how to adopt for design

COURSE CONTENTS:

UNIT I:

Introduction to Surveying–Importance of surveying to engineers. Types and classification of survey. Principles of surveying character of work,shrunk scale. Definition of maps and understanding topographical maps of survey of India. Shrunk scale problems.

Chain Survey: Instruments used, Types of chain, Instruments for ranging,Setting out angles, erecting perpendiculars.

Plane table survey: Accessories, Advantages and disadvantages of plane table survey, basic definitions, principles of plane tabling, setting up and orientation, methods of plane tabling: radiation and intersection, plane table traversing.

UNIT II:

Leveling –basic definitions, classification of leveling methods, types of levels-dumpy level, temporary adjustments of dumpy level, reduction of levels, plane of collimation method, problems, profile leveling-methods and application, fly leveling

Contouring: Characteristics of contours, direct and indirect methods of contouring, interpolation, and uses of contours.

UNIT III:

Theodolite- study of transit Theodolite and function of parts- temporary adjustments, measurement of horizontal angles- repetition and reiteration, measurement of vertical angles, contouring- definition, uses of contours, characteristics of contours,

Observations of a Site (Up to 1 acre): Survey without instruments using geometry and one's own body. To learn to read the terrain by intuition and by measure, including photography as a surveying method.

Analysis of a Site (Up to 1 acre): On site factors; Analysis of natural factors, topography, hydrology, soils, landforms, vegetation, climate, microclimate. Influence of water bodies

UNIT IV:

Total station: electronic Theodolite integrated with an electronic distancemeasurement to measure slope distances. GIS and its application

Studying survey drawings: Learning to read a land survey drawing; type of land survey drawing, Scale and North direction in drawing, legend or list of the symbols used on drawings, counter indications on a drawing, grid references for measurements etc.

Field Work-1: Setting out works such as center lines of a building (workingdrawings of a small residence to be provided)

COURSE OUTCOMES:

1. Acquire the skills related to surveying and leveling .
2. Conduct the surveys of land of medium complexity
3. Interpret survey plans.

REFERENCES:

1 Punmia, B C, Jain, Ashok K & Jain, Arun K Surveying Vol I Laxmi Publications

2 Punmia, B C, Jain, Ashok K & Jain, Arun K, Surveying Vol IILaxmi Publications

3 Roy, S K,Fundamentals of Surveying & PHI Learning Pvt Ltd

4 Bhavikatti, S S Surveying, Thoery&Practice,I K International

8. COMPUTER I

Course Code	**Course Title**		**L**	**P**	**D**	**Total**	**Contact Hrs.**
BR17AR407	**COMPUTER I**	HC	1	1	0	2	3

COURSE OBJECTIVES:

- To train students to use computers and digital media as tools
- Equip the student with a range of digital tools and techniques in drafting, 3D modeling

COURSE CONTENTS:

UNIT I:

Introduction to Drafting software such as CAD etc.

CAD:2D commands, viewports,dimensions, annotations. Time problemintroduction; Classroom exercises such as measured drawing of studio (windows, doors and staircases included), architecture department (windows, doors and staircases included) etc.

Understanding layers, paperspace Vs model space, line weights, print set up and Modeling of Wall, Doors, Windows, Stairs etc. Single line plan of building

UNIT II:

2D drafting: Presentation of time problem; plan, sections, elevations of abuilding, of singlestoreyed building, of previous semester architectural design studio project.

2D drafting: Presentation of time problem; floor plan with furniture layout,enlarged construction details.

UNIT III:

Isometric views: Presentation of time problem; drawing quickly with basicshapes, isometric view,Adding detail to view in 3D space, use of cameras, material applications. Presenting models - to juryor clients.

Preparation of drawings and details drafted in Building construction studio in to Autocad.

UNIT IV:

Introduction to 3d modeling softwares such as Google sketch up etc. Google Sketch Up or relevant 3D modeling software–Introduction to 3Dmodelling software interface, demonstration of 3D modeling commands required to convert 2D projectinto 3D.

3D massing of built forms studied in History of Architecture and Theory ofArchitecture

COURSE OUTCOMES: The students will be able to

1. Acquire Knowledge in CAD and digital media as tools
2. Represent architectural ideas through these tools
3. Employ digital tools and techniques in drafting, 3D modeling

REFERENCES:

1 Jayaram, M A &Rajendra Sapna Prasad, D S, CAD in Civil Engineering A Laboratory

2 Online documentation, http://www.sketchup.com/learn/videos

3 Adobe creativesuite,Adobe products: www.adobe.com

9. CONTEMPORARY ARCHITECTURE (ASIA)

Course Code	Course Title		L	P	D	Total	Contact Hrs.
BR17AR4081	Contemporary Architecture (Asia)	SC	4	0	0	4	4

COURSE OBJECTIVES:

- An overview of Architecture in India and rest of Asia, Post- Independence up to current trend post 2000
- Understand the need for different building typologies that were necessitated by changing economies and policies.
- The creation of New City capitols.
- Study the ideologies of architects based on materials, Geographies and other factors through their design.

UNIT I:

Post Independent India:

Understand the changes in Architectural building typologies with the creation of Institutions, Industry and Urbanization due to "Nehruvian" ideology. Influence and concepts of well-known architects in India, Bangladesh and Sri Lanka from 1940 to 1970

UNIT II:

Creation of new Capital cities:

Chandigarh, Gandhi Nagar and other cities.

UNIT III:

Influence and concepts of well-known architects in India, Bangladesh and Sri Lanka from 1970 to 1990's. Parallel trends in Indian architecture like Revivalist- monumental, Religious, Experimental buildings and the influence of alternative Building technologies.

UNIT IV:

Current trends in India and Asia due to changing economies. The rapid urbanization of Mumbai, Chennai, Bangalore, Delhi and Kolkatta adding a new dimension to City scapes. Changing trends in working styles influencing Architecture; creation of "Tech"cities.

Students shall take up works of Architects for research and self- study culminating in seminar presentations.

For each Unit, the Faculty member handling the course shall include the works of Architects as appropriate.

COURSE OUTCOMES: The student will be able to

1. Explore contemporary Architecture trends and issues
2. Associate the ideologies of architects and their design to present day context

REFERENCES:

1 Jon lang, A concise History of Modern architecture in India, Permanent Black

3 Slessor, Catherine Contemporary Architecture, The Images

4 Baborsky, Matteo Architecture, Wiley Siro.

5 Bahga and Bahga, Modern Architecture in India

6. Anupama Kundoo, Architecture of Auroville and PoppoPingel

Contemporary Architecture of Europe &other countries

Course Code	Course Title		L	P	D	Total	Contact Hrs.
BR17AR4082	**Contemporary ArchitectureofEurope&other countries**	SC	4	0	0	4	4

COURSE OBJECTIVES:

- An overview of contemporary Architecture in Europe post World War II up to current trends.
- The process of re-building cities and need for new building typologies.
- Understand changing trends due to urbanization and sub-urbanization of European cities.
- Works of current Architects and their ideologies influencing the design.

UNIT I:

Influence and concepts of well-known architects of Europe and Japan from 1940 to 1970. Architectural style of a continent emerging Post World War. Early works of the European master Architects.

UNIT II:

Process of Re-building of cities and new emerging style, City centers, Expositions, Religious buildings etc.Later works of European masters and Influence of Japanese Architects on the rest of the world.

UNIT III:

Creation of Iconic Architecture like stadiums, Museums and other building typologies post 1990's upto the current era post 2000's.

UNIT IV:

Students shall take up the works of Current architects and study their style and ideologies influencing the design in detail, presenting the work through seminars.
For each unit, the Faculty member to prepare the list of architects and buildings while preparing the course plan.

COURSE OUTCOMES: The student will be able to

1. Explore contemporary Architecture trends and issues
2. Associate ideologies of architects and their design to present day context

REFERENCES:

1 Rodgers, Nigel, The Rise & Fall of Ancient Rome,Anness

2 Slessor, Catherine,ContemporaryArchitecture,The Images

3 VVLN Murthy,Modern, postmodern architecture &Standard,Pioneer architects Publishers

4 Fletcher, A History of Architecture, Bannister, BannisterFletcher

5 Frampton Modern Architecture by Kenneth ,Kenneth, Frampton – A Critical history

11. CONTEMPORARY ARCHITECTURE (NORTH & SOUTH AMERICA)

Course Code	Course Title		L	P	D	Total	Contact Hrs.
BR17AR4083	Contemporary Architecture of North and South America	SC	4	0	0	4	4

COURSE OBJECTIVES:

- An overview of contemporary Architecture in Americas post World War II up to current trends.
- The process of creating metropolitan cities and need for new building typologies, post the Great Depression.
- Understand changing trends due to urbanization and sub-urbanization of cities.
- Works of current Architects and their ideologies influencing the design.

UNIT I:

- Influence and concepts of well-known architects of United States of America from 1940 to 1970
- Need to create a positive identity Post the great depression. Creating New Capital cities.

UNIT II:

Process of creating "Downtowns" establishing the Architectural style. Works of European Architects who migrated to the United States post World War II. Later works of American master Architects.

Decentralization of Cities and creating Sub-urbs. Emergence of styles based on Alternative building technologies, new age religions and Institution towns.

UNIT III:

Influence and concepts of well-known architects of North and South America from 1970's to 1990's.Silicon Valley and creation of a new identity.

UNIT IV:

Students shall take up the works of Current architects of the Americas and study their style and ideologies influencing the design in detail, presenting the work through seminars.
For each Unit, the Faculty member to prepare the list of architects and buildings while preparing the course plan.

COURSE OUTCOMES:

1. Explore contemporary Architecture trends and issues
2. Associate ideologies of architects and their design to present day context

REFERENCES:

1 Jeong, Kwang, The Leader of Architecture, Top Jeong, Kwang Young Young Architects USA

2 Slessor, Catherine Contemporary Architecture, The Images

3 Baborsky,Matteo Architecture ,Wiley Siro

4 VVLN Murthy, Modern, postmodern architecture &Standard Publishers, Pioneer architects

5 Bannister Fletcher,A History of Architecture,

6. Frampton, Modern Architecture – A Critical Kenneth History

FIFTH SEMESTER

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR501	**Architecture Design-V**	HC	4	0	2	6	8

Studio Theme: Community living

Students shall get an understanding of increasing complexities from single dwelling to multiple dwelling units.

- To illustrate agglomerations of multiple building units (eg Multi storied Apartments with club house, play areas etc. or Campus Housing)
- To demonstrate and develop different Habitation types in an urban setting, implementing Building bye laws pertaining to Set backs and Parking norms.
- To integrate building services like water supply, drainage, rainwater harvesting, power back up into the design.

COURSE OUTCOMES: On completion of the course, the student shall be able to

1. Characterize Residential planning principles and Elaborate on details of bye laws
2. Demonstrate Space Planning principles for multiple buildings on a single site, including open space planning, Incorporate basic services in design
3. Communicate the design using architectural tools such as AUTOCAD

Course Contents:

UNIT – I

Case study and literature study of selected Design type. Site selection and Site study in urban location

UNIT - II

Drawing up specific design requirements that are site specific. Development of Form and splitting of units with Vehicular and Pedestrian circulation resolved.

Continuous emphasis on controls, codes and bye-laws.

UNIT – III

Development of drawings for detailed units (Habitation and others). Adopting norms, structural aspects (grid planning) and incorporating building services.

UNIT -IV

Detailed Design and Models using computer aided software or Manual drawings.

STUDIO PROJECTS:

Major Project:

Apartment housing with added infrastructure like clubhouse, shopping, Interactive open spaces etc OR Resort Type Hotels with multiple units and landscaped areas for public interaction, OR Serviced apartment complexes in City Centers with added infrastructure like club, shopping, offices etc.

Time bound problems: They are the effective ways to learn to give quick solutions that can be implemented. It tests the logical ability and presentation skills that are very much required in the real world.

Detailing of a unit within the larger design can be taken up for this.

For eg: Adapting new techniques of roof cover to be applied to a public interactive space, thereby understanding relation between Built and Un-built spaces.

Reference books:

1. Time savers standards for architectural design data – by John Callender (Editor)
2. Architectural design data – by Ernst Neufert.
3. Hotel and Resort Design- Anne M Schmid and Mar Scoviak – Lerner

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR502	**Building Materials & Construction Technology –V**	HC	2	0	2	4	6

Course Objectives:

Students are introduced to

- Introduce the constructional systems of partitions in advanced and latest materials.
- Comprehend and apply knowledge of advanced roofing technologies for large span and complex buildings.
- Plastics in Building industry as a material
- Protective treatments in buildings.

Course Outcome:

the student will be able to:

1. Identify varied materials and techniques used in Partition construction.
2. Extend knowledge gained to design large span roofing systems.
3. Explore various methods and materials of cladding and glazing .

Course Contents:

UNIT I:

Partitions (dry walls) and Ceiling Treatments: Construction of partitions in various materials, timber and metal, fixing methods, design glazed partitions, sound proof partitions etc with doors, partitions of Different heights, cabin construction (materials used –wood, glass, particle boards, Pre-laminated boards etc). Double glazed partitions, aluminum/ steel sections.

UNIT II

Cladding and Structural Glazing (Curtainwalls), Different types of framing systems, spider connections

UNIT III:

Introduction to advanced roof forms: Introduction to Tensile and Pneumatic structures, advantages and disadvantages, fixing details, construction details. Properties and usage of Synthetic material (sketches). Shell roofs, folded plates, domes, geodesic dome. (PEB Buildings)

UNIT IV

Material study: Protective measures for foundation, Masonry walls and wood work.
Plastics as a building material, types, properties and uses of plastics such as polycarbonates, acrylics, PVC polymer films, and fiber reinforced plastic. Application and details

Properties and usage of Insulation material like glass wool, rubber.

Reference Books:

1. "Construction Technology" By Chudley
2. "Construction of Buildings" By Barry
3. "Building Construction, Principles, Practice and Materials" By Hardie Glen
4. "Text Book of Building Construction" By Arora &Bhindra
5. "Tensile Fabric structures: Design, Analysis and construction", By Craig G. Huntington
6. "Building Construction Illustrated" By Francis D K Ching

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR503	**Energy Efficient Buildings**	HC	2	0	1	3	4

Course objective:

• To inform the need of energy management and conservation in building design and construction

• To familiarize the students with passive design considerations and strategies

• To inform about the various rating systems for Green building design

Course outcome:

On completion of the course, the student shall be able to

1. Outline the principles of sustainable and energy efficient building design
2. Attain an ability to apply passive design strategies in design.
3. Describe green building rating systems and their significance.
4. Apply the techniques learnt through software into design.

Course Contents:

UNIT I

Introduction to Energy Efficiency in the contemporary context, Concept of embodied energy of material, Ecological footprint of a building, Concept of carbon neutrality, Green buildings.Direct Gain Thermal Storage of Wall and Roof - Roof Radiation Trap - Solarium - Isolated Gain-Evaporative Cooling - Nocturnal Radiation cooling - Passive Desiccant Cooling – InducedVentilation - Earth Sheltering - Wind Tower - Earth Air Tunnels

UNIT II

Energy management and rating systems

Introduction to Energy Management of Buildings and Energy Audit of Buildings; Energy Conservation Building Code (ECBC). Rating systems for green building- LEED, IGBC, GRIHA etc. Case study of LEED rated buildings.

Areas for innovation in improving energy efficiency such as Photo Voltaic Cells, Battery

Technology, Thermal Energy Storage, Recycled and Reusable Building materials,

Nanotechnology, smart materials and the future of built environment

UNIT III

Case study:

Case study of an energy efficient building. Analyzing different techniques adopted in a building. Formulating strategies of energy efficiency.

Different software's available to analyze the energy efficiency (in design, eco-tech etc).

UNIT IV:

Application criteria's:

Applying different strategies to their design projects done in previous semesters, demonstrating with different software's learnt.

References:

1. "Housing climate comfort" by Martin Evans.
2. "Green Architecture"-Design for a sustainable future by Brende and Robert vale.
3. "Green Architecture"-A guide for sustainable design by Michael J Crosbie.

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR504	**BUILDING SERVICES -II**	HC	1	0	1	2	3

Course Objectives:

- Elaborate on application of electrical services in design & construction.
- Outline the current and prospective materials used in electrical services for buildings.
- Impart practical knowledge of electricity and illumination applications used in current architectural practice.
- Train the students to comprehensively plan and design the electrical and illumination requirements of building design.

Course outcomes: On completion of the course the student will be able to:

1. Acquire knowledge on Planning and design of electrical services for simple spaces.
2. Compute required illumination levels for different tasks.

Identify materials and techniques used in electrical services in Buildings

Course Contents:

UNIT – I

Electricity

Introduction to electrical services. Transmission and Distribution of electricity to different categories of buildings, various devices and processes involved in it. Different types of service connections.

Protection systems against electrical threats to buildings.
Different types of distribution systems in buildings. Various materials involved in it. Power requirement for different categories of buildings. Preparation of electrical drawing using correct graphical representation for a residence plan.

UNIT – II

Illumination

Quality and quantity of light; Factors influencing quality of light. Methods of lighting – Ambient, task and accent lighting. Lighting aspects for various categories like street lighting,factory lighting.

Systems of luminaries, direct, indirect, etc.

Various types of electrical lamps for different usages – incandescent, fluorescent/CFL, HID's, neon, LED lamps and their lighting characteristics, application criteria's; Design considerations for different types of occupancies and tasks and calculation of lighting requirement

UNIT – III

Safety Measures against Fire

Role of architect in providing fire safety to buildings, Fire resisting materials. Passive fire protection in different categories of buildings. Fire hazards, Fire loads. Fire precaution, Fire prevention. Provisionof smoke detectors, fire alarms. Difference between **Firefighting** and **Fire prevention**

UNIT IV

Active fire protection-Extinguishers, Sprinklers, firefighting lobby etc; Systems adopted in various buildings against fire.

Case studies: Case studies of some Fire disasters and their reasons: Fire Norms by NBC, Calculation of Occupant load and min doorway widthCalculation of Fire exits, Concept of Pressurization, Fire liftsand Fire Staircasesregulationsetc as per bye-law.

References:

1) H Cotton, Electrical Technology
2) L. Uppal, Electrical wiring, Estimating & Costing
3) Anwari., ElectricalEngg.
4) M.S.N. Swamy, Lighting, MSN Marketing, Bangalore.
5) TorquilBarker,Concepts in Practice lighting, 1997, B.T. Batsford Ltd, 583,fullham Road, London.
6) Dr. FrithAbnwos and others. Electrical Engineering handbook.

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR505	**Structures – V**	HC	1	0	2	3	3

COURSE OBJECTIVES:

- To give students an understanding of singly reinforced beams, doubly reinforced beams.
- To acquaint with various issues relating cantilever beams, lintels and chajja.
- Introduce principles of Tensile structures & pneumatic structures.
- Explain the theory of pre- stressed and pre-cast concrete.

COURSE OUT1COMES: On successful completion of the course students shall be able to

1. Differentiate between principles& types of reinforced beams.
2. Draw fixing details of Tensile structures & pneumatic structures
3. Describe the structural behavior of pre- stressed and pre-cast concrete
4. Elaborate on types of advanced concrete.

COURSE CONTENTS:

UNIT I:

Analysis and structural behavior of singly reinforced beams and doubly reinforced beams, Cantilevered beams, lintels and slabs. Situations where doubly reinforced beams are used.

UNIT II

Structural behavior of Tensile structures & pneumatic structures (No problems to be solved for these)

UNIT III

Basic concepts of Pre-stressed concrete, pre-stressing materials.

Behavior of pre-stressed concrete beams, columns, footings, slabs, Introduction to pre-cast and assembling of pre- cast members.Adopting of precast members in bridges and modular building units.

UNIT IV

Advanced concrete, Ferro cement concrete, Ferro Crete, Fiber reinforced concrete, Castacrete, mega-crete, thermocrete.

REFERENCES:

1. Krishna Raju N " structural design and drawing" (RCC & steel).

2. Krishna Raju N " Prestressed concrete".

3. Sushil Kumar " Building construction".

4. Bhavikatti S S " strength of materials".

5. Dongre A P " Structural engineering for architects”.

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR506	**Computers In Architecture – II**	HC	1	0	1	2	3

Course Objectives

- To deliver the working knowledge of advanced software
- To demonstrate building of 3D models and conceptual architectural masses
- To Illustrate rendering of photo-realistic images
- To develop their skills in editing and rendering of architectural drawings

Course Outcomes:

On completion of the course the student will be able to:

1. Explore any advanced software as a 3D modeling tool
2. Convert 2D drawings into 3D drawings using advanced software.
3. Visualize the Materials & Lighting aspects of Design & create realistic renderings.
4. Explore Photoshop as a rendering tool
5. Develop good design presentations & Compositions with the help of advanced software.

Course Contents:

UNIT 1

3D modeling: Use of Sketch up or any 3D software. Conversion of previous semester AD project(2D) into 3D model, adding detail to Models in 3D space, use of cameras, material applications.

UNIT 2

Rendering & Visualization: Introduction to concepts of visualization using rendering engines such as VRay.

UNIT 3

Introduction to graphics editing tools: Adobe Photoshop. Concepts of image editing, image scanning, effects, filters.

UNIT 4

Graphics editing software: – Classroom exercise to demonstrate use of Adobe Photoshop in simple projects. For e.g., rendering of 2D drawings, adding nature to 3D visualizations of architecture design project.

REFERENCES

1. Modeling with SketchUp for 3D Printing by Bonnie Roskes
2. Modeling with SketchUp for Interior Design by Bonnie Roskes
3. SketchUp Pro 2013 step by step by Joao Gaspar
4. An introduction Adobe Photoshop by Steve Bark
5. Adobe Photoshop 7.0 for photographers: A professional image editor's guide by Martin Evening

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR507	**Vacation Assignment/ Study Tour /Summer Course**	HC	0	0	2	2	-

Course Objectives:

- To encourage independent learning without supervision
- To nurture creativity and innovative thinking through workshops and experiential learning.
- To engage with Architecture in a positive way through outside classroom experiences.

During Vacationsthe students are expected to do some retrospection, exploration and recharge their creativity to combat the pressure of the upcoming semester.

Students are encouraged to undertake a study tour in India or International pertaining to Architectural Design Studio, History, Climatology or any other course related to the upcoming semester. The trip will include documentation work that shall be intended to enhance and support classroom learning.

Outside classroom learning can also be encouraged in the form of entrepreneurship initiative and / or development of a business model related to Architecture. For eg: Development of a mobile “Application” that can benefit the public.

Summer course conducted by the University may also be taken up by students and Grades given by the faculty handling the course may be considered for the assessment.

Course Outcomes:

1. Acquire independent learning
2. Achieving creative output with the help of workshops/hands on experience

SOFT CORE COURSES

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR5081	**VERNACULAR ARCHITECTURE**	SC	4	0	0	4	4

COURSE OBJECTIVES:

- To outline the various approaches and concepts to the study of vernacular architecture.
- To classify and categorize vernacular architecture forms based on different regions of the country.
- To Determine the Impact of the Colonial rule on the Vernacular architecture in India.

COURSE OUTCOMES: On completion of the course the student shall be able to

1. Define the term 'Vernacular' and outline the importance of studying domestic buildings of the past.
2. Acquire knowledge on the classification of prototypes in different regions and learn some of the finer details in terms of Plans and sections.
3. Associate the planning principles in Vernacular architecture to Climate, Geography, Geology, Socio- cultural factors.
4. Compare and correlate differences and similarities between vernacular styles in different regions.

COURSE CONTENTS:

UNIT-I

INTRODUCTION

Definition and classification of Vernacular architecture – Vernacular architecture as a

process – Survey and study of vernacular architecture: methodology- Cultural and contextual

responsiveness of vernacular architecture: an overview. Different approaches and concepts to the study of vernacular architecture: an overview –

Aesthetic, Architectural and anthropological studies in detail

UNIT-II

VERNACULAR ARCHITECTURE OF THE WESTERN AND NORTHERN

REGIONS OF INDIA

Forms spatial planning, cultural aspects, symbolism, color, art, materials of construction and construction technique of the vernacular architecture of the following:

Deserts of Kutch and Rajasthan; Havelis of Rajasthan

Rural and urban Gujarat; wooden mansions (havelis); Havelis

Geographical regions of Kashmir; house boats

UNIT-III

VERNACULAR ARCHITECTURE OF SOUTH INDIA

Forms, spatial planning, cultural aspects, symbolism, art, color, materials of construction and construction technique, proportioning systems, religious beliefs and practices in the vernacular architecture of the following:

Kerala: Typologies: Koothambalam, Nallukettu and other traditional forms.

Tamil Nadu: Houses and palaces of the Chettinad region and Temple towns.

UNIT IV

COLONIAL INFLUENCES ON VERNACULAR ARCHITECTURE OF INDIA

Colonial influences on the Tradition Goan house - Evolution of the Bungalow from the traditional Bangla, Victoria Villas – Planning principles and materials and methods of construction.

Settlement pattern and house typologies in Pondicherry and Cochin.

REFERENCES:

1. Paul Oliver, Encyclopedia of Vernacular Architecture of the World. Cambridge University Press, 1997
2. Amos Rapoport, House, Form & Culture. Prentice Hall Inc.1969
3. R W Brunskill: Illustrated Handbook on Vernacular Architecture. 1987
4. V.S. Pramar, Haveli: Wooden Houses and Mansions of Gujarat.Mapin Publishing Pvt. Ltd., Ahmedabad, 1989
5. Kulbushanshan Jain and Minakshi Jain: Mud Architecture of the Indian Desert. Aadi Centre, Ahmedabad, 1992

6. G.H.R. Tillotsum: The tradition of Indian Architecture Continuity, Controversy – Change since 1850. Oxford University Press, Delhi, 1989
7. Carmen Kagal: VISTARA – The Architecture of India.The Festival of India, 1986
8. S. Muthiah and others: The Chettiar Heritage; Chettiar Heritage 2000

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR5082	**Conservation**	SC	4	0	0	4	4

Course Objectives:

- To introduce students to conservation processes of historical precincts.
- To define the Stages of conservation, different agencies involved in conservation process.

COURSE OUTCOMES:

1. Explore the different types of conservation process
2. Assess the condition and value of a heritage building.
3. Explore the different levels of intervention in a heritage building.

Describe the principles of conservation
Course Contents:

UNIT –I

Introduction: Definition, types, need; principles, ethics & value; tangible & intangible components, Degree of Intervention; Evaluation & assessment; Documentation; Procedures & techniques; Concepts & prevailing practices in conservation, restoration, retrofitting, rehabilitation, consolidation, protection, adaptive reuse. Architectural Conservation: Preservation & conservation philosophies; Pioneers & societies in field of conservation; International Charters; International approaches from UNESCO, ICCROM, GETTY foundation, etc.; National approaches: A.S.I., State Archeology, INTACH, Urban Art Commission, Heritage Commissions, local bodies, etc.; Techno legal provisions, codes & byelaws for interventions.

UNIT II

Assessment of Building Condition: Understanding of original building conditions; Documentation of current conditions- non-destructive survey methods, environmental monitoring, simple & sophisticated analytical methods; Types & causes of damages; Damage to building components & structural systems - superstructure & substructure; Location & degree of damages - defect monitoring methods, their impact - diagnosis of failure & damages.

UNIT III

Preservation Techniques In Architectural Conservation: Analysis of problem; Types , Degrees & Limitations for intervention; Levels of intervention- Structure, building complex, precinct & heritage zone; Provision of solutions for repair & replacement of components; Restoration (in case of living monuments), preservation, reconstruction & maintenance. Sequence & phasing; Materials & methods; Detailing & finishing.

UNIT IV

Case Studies in Architectural Conservation: Examples of iconic conservation projects; Heritage zones; Conservation strategies- documentation, analysis, techniques, interventions & outcomes; Models of preservation, reconstruction & adaptive reuse. Influences & benefits - Physical, contextual, political, social, cultural, economic, ecological, tourism, technological, material, spatial & visual.

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR5083	**Housing**	SC	4	0	0	4	4

Course Objectives:

- Introducing the basic concepts and issues related to housing.
- Trace the evolution of Housing
- Elaborate on housing policies, methods and innovative solutions

COURSE OUTCOMES

1. Demonstrate a firm grasp of housing related issues in the global context.
2. Acquire knowledge of modern concepts and innovative ideas to address housing issues.
3. Employ concepts learnt to arrive at innovative design solutions in Housing

Course Contents:

Unit – I

Basic concepts in housing- density, dwelling units size, household size, housing quality Importance of housing, Stakeholders in housing- users, housing agencies, policy makers Brief review of the historical development of housing in various contexts.
Housing standards for rural and urban areas
Housing stock, Housing need and Demand, housing shortage

Unit – II

Evolution of Housing policy and perspective at the national level from 1950s to present.
Brief introduction to the problem of slums in urban areas and strategies for slum up gradation

Concepts of Social housing, housing affordability, inclusiveness
Case studies of social housing from India and abroad

Unit – III

Housing design-Traditional pattern of housing design Row Housing, Cluster Housing layout of concepts, low rise verses high rise housing with examples

Relevance of Residents' Satisfaction in housing, Factors that affect residents' satisfaction in housing, psychosocial considerations, preparation of questionnaire and mock survey in different housing typologies

Unit – IV

Case studies of innovative housing projects from around the world covering concepts such as flexible/modular housing, Disaster resilient housing, innovative usage of materials, Climate sensitive housing, participatory housing etc.

Reference books:

1. ChattopadhyaySubrata, New Essays on Inclusive housing. Macmillan Publications.
2. Chiara, De Joseph, and Others. Timesavers standard for Housing and Residential development.2" ed. McGraw Hill, Inc, New York.
3. Desai, A.R. and Pillai, Devadas. Slums and Urbanization. Popular Prakashan Pvt. Ltd.
4. HUDCO. Housing for the Low Income. HUDCO.
5. Poulose, K. Thomas. Reading Material on Housing. Institute of Town Planners. New Delhi.

SIXTH SEMESTER

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR601	**Architecture Design-VI**	HC	4	0	2	6	8

Course Objectives

- To outline the design principles of large scale projects (in site with contours-hilly terrain).
- To Illustrate that designs must respond to climate, environment and ecological factors.
- To integrate master plan with landscape details, circulation and services.

Course Outcomes:

On completion of the course the student shall be able to:

1. Outline the Site planning principles
2. Elaborate on Landscape details
3. Extrapolate Contour Analysis into the campus design
4. Demonstrate an ability for Space Planning.
5. Extend the knowledge of all the services to be incorporated in design.

Course Contents:

UNIT -I

Theme and Focus of Design: Climate responsive architecture:

Projects shall be of larger scale with multiple functions. Design emphasis shall be on response to climate, environment and ecological factors. Understanding, exploration & development of design programme concept & detailed design with focus on climate, environment and ecological factors. The literature study and case studies are part of above study.

UNIT -II

The design issues to be addressed for the design project pertaining to larger projects are

- Issues in Preparation of Master Plan for the project undertaken.
- Phases of development and scope for expansion.
- Comfortable Vehicular and pedestrian movement.
- Landscaping and Services.
- Details pertaining to the disabled.

UNIT –III

Identity hierarchy of spaces, public and private scales of space. The design has to respond to climate, environment, and ecology.Detailing of a common major block or a public space of larger project. The usage of materials, construction techniques must respond to environment.

UNIT –IV

Exploration, analysis, detailingofany 2 blocks of the larger project in response to environmental aspects. The design shall be sensitive to the needs of disabled, aged people and children.

Design Exercise: Large scale Institutional Design (Campus Planning) / Commercial / Industrial / Housing / Public use project of diversified activities with focus on horizontal & / or vertical circulation & grid planning. Typology: Campus, Housing, Institutions, Government complexes/offices Site extent: Upto 20000 m2.

References:

1. Time Saver Standards for building Types- Joseph De Chiara & John Callender
2. Time Saver Standards for Architectural Design Data-John Hancock Callender
3. Neuferts's Standards
4. Hotel and Resort Design- Anne M Schmid and Mar Scoviak– Lerner

Students may be required to develop a brief, translate it in to requirements and Design.

At least one major exercise and one minor design/ time problem should be given. The topics not covered as design problems will have to be covered by the studio faculty members through lecture/slide show session and site visits.

The evaluation shall be through periodic internal reviews.

The students must present the entire semester work for assessment along with Model.

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR602	Building Construction, materials& Working Drawings	HC	2	0	2	4	6

Course Objectives: Students are introduced to

- Working drawing of a project.
- Preparation of detail drawings of floor plans, sections, elevations.
- Preparation of detail drawings of all services.

Course Outcome:

On completion of the course the student will be able to:

- Produce detailed working drawings of a project.

Course contents:

UNIT I

Introduction and importance of detailed working drawings in architectural practice. Creating working details for a residential / commercial project starting with foundation/footing and wall details

UNIT II

Introduction to creation of working details of doors, windows, staircase and floors. Showing working details of interiors, bathrooms, W.C. electrical, plumbing and fittings.

UNIT III

Sections, Elevations; Wall sections; Section through stairs & toilet is mandatory

UNIT IV

Roof Plan including roof drainage, Stair room plan.

All Units to include drawings & details; estimation & specifications. Final outcome will be reviewed in the form of a VIVA where the working drawings produced in each unit using software will be presented.

References:

- "Construction Technology" By Chudley
- "Construction Of Buildings" By Barry
- "Building Construction, Principles, Practice And Materials" By Hardie Glen
- "Text Book Of Building Construction" By Arora &Bhindra
- "Building Construction Illustrated" By Francis D K Ching

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR603	Estimation, Costing and Specification	HC	3	0	0	3	3

Course Objectives:

- To provide the student sufficient knowledge of estimation in order that he can advise prospective clients on project viability and monitor/ control project cost.
- To provide the student adequate knowledge to write the specifications for a given item of work, to work out the unit cost of individual items based on their specifications and arrive at the overall cost of the project.
- To enable the student to write specifications for diverse items of civil works with a view of controlling quality of work executed at site.

COURSE OUTCOME

The student shall be able to

1. Enumerate the detailed list of items for preparation of an estimate for a simple building.
2. Derive detailed specifications for items enumerated for construction.
3. Compute the rate analysis for simple residential buildings.

Course Contents:

UNIT I

Introduction to specification

Specification- Definition, purpose, procedure for writing specifications for the purpose of calling tenders, types of specification. General specifications for 1^{st}, 2^{nd}, 3^{rd} and 4^{th} class buildings.

Specification for different items

Specifications for the following items – Bricks; sand; cement; coarse aggregate; water; reinforcement; storing and handling of materials; Earth work in foundation; PCC; RCC; First class brick work in cement mortar; half brick thick partition in cement mortar; reinforced brick work; DPC; glazed tiles in skirting and dado, cement plaster; joinery in wood, steel & aluminum; paintingto walls – cement paint, oil bound distemper, acrylic emulsion, enamel paint ; painting to joinery ; varnishing ; French polishing ;

UNIT II

Introduction to estimation

Estimation– definition; purpose; types of estimate; various methods of approximate estimate of buildings study of various drawing with estimate, abstract method of taking out quantities and cost-center line method, long wall and short method or crossing method.

UNIT III

Rate analysis

Rate analysis– definition; method of preparation; quantity and labor estimate for unit work; task or outturn work; rate analysis for: earth work, concrete works, first class brick work, reinforced brick work, cement plastering, DPC with cement mortar/ concrete, finishing (cement paint, distemper, acrylic emulsion, enamel paint) to walls & ceiling.

UNIT IV

Detailed estimate

Detailed estimate– data required, factors to be considered, methodology of preparation, abstract of estimate, contingencies, work-charged establishment, bill of quantities, different methods for estimating building works, methods of measurement of works.

References:

1. M. Chakraborti: Estimation, Costing, Specification and Valuation in Civil engineering.
2. Dutta:Estimating and Costing, S. Dutta and Co., Lucknow 1983
3. PWD Specifications of Karnataka State Government,
4. CPWD Specifications of Government of India

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR604	Building Services – III	HC	3	0	0	3	3

Course Objectives:

To enable students to:

- Study mechanical services in a building
- Integrate & coordinate the services knowledge in architectural Design Study
- To analyze latest trend, materials in HVAC and Vertical Transportation.

COURSE OUTCOME:

The students are able to

- Incorporate mechanical services in a building
- Explore new techniques & latest materials in air conditioning like energy efficient chillers, energy conservation techniques.
- Integrate & coordinate the services knowledge in architectural design

Course Contents:

UNIT – I

Mechanical ventilation, ventilation for a cinema hall, Air-conditioning for human comfort & definitions, Dust control and filters, Air cycle, Refrigeration cycle, components, Air distribution - ducts, grilles etc, Classification and application air-conditioning, Heat load estimation & thumb rules

UNIT – II

Window unit, Split units without ducts, Spit unit with duct, Package unit with ducts, Direct expansion system, Chilled water system, Humidifiers& dehumidifiers

UNIT – III

Introduction to vertical circulation, Lift well, pit, doors, car, machine room etc. Typical section through lift, quality & quantity of service, Types of lifts Lift bank, lobby and lift interiors, Hydraulic &traction lift, Escalator &travellator, Lift act, architect's role, Double Decker lift, sky lobby, current scenario.

UNIT –IV

Graphical representation of advanced services for a particular project carried out in previous semester may be of public or commercial building, like air conditioning details, fire escape routes, firefighting facilities like portable and non-portable systems.

References:

1. Principles of Air-conditioning by Paul Lang, D B Taraporevala Sons & company Limited
2. Building Service Engineering – by David V Chadderton, E & FN SPON – an Imprint of Chapman & Hall
3. Building Construction illustrated by Frnacis D K ching, CBS Publishers & Distributors
4. Building Environment – By Dr. AjithaSimha, Tata Mc-Graw Hill Publisher Co Ltd, ND
5. Mechanical System for Architects by Aly S Dadras, Mc-Graw Hill, Inc.
6. Lifts – company manuals / Brochures

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR605	Structures VI	HC	2	0	1	3	3

COURSE OBJECTIVES:

- To give an understanding of special structural forms.
- Explain the theory behind tall structures, earthquake resistant structures.
- Introduce the concepts of floating, suspended structures and bridges

COURSE OUTCOMES: On successful completion of the course the student shall be able to

1. Explain about various earthquake resistant structures
2. Elaborate on tall buildings- loads and forces calculation
3. Define floating structures

Describe Suspended Structures

COURSE CONTENTS:
UNIT I:

Introduction to earthquake resistant structures, types of waves, earthquake zones according to IS code. Causes of earthquakes, seismic waves, magnitude, intensity, characteristics of strong earthquake ground motions.

UNIT II:
Introduction to tall buildings, development & uses.
Loads & forces on buildings. Vertical forces, Horizontal forces, internal forces

UNIT III:
Introduction to Floating structures, different types, and techniques used.
Case studies through literature, appropriate website.

UNIT IV:
Introduction to Suspended structures and Bridges

VIVA will be comprising of a combination of Design & Portfolio sheets.

4.

References:

1. Krishna Raju N " structural design and drawing" (RCC & steel).
2. Krishna Raju N " Prestressed concrete".
3. Dongre A P " Structural engineering for architects".
4. Pankaj Agarwal, Manish shrikhande" Earthquake resistant structures".
5. David J dowrick" Earthquake resistant design"

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR606	**Advanced Computer Aided Design**	HC	1	0	1	2	3

Course Objectives:

- To develop skills required in using computers as a tool for architectural design representation
- To develop techniques for visualization & to create outputs using advanced software.

Course Outcomes:

On completion of the course the student will be able to:

1. Use advanced software for Building visualization & Design representation.
2. Visualize the Materials & Lighting aspects of Design & create realistic renderings.
3. Design and document all design details using this software.

Course Contents:

UNIT I

Introduction to 3D modeling: – Introduction to concepts of BIM (Building Information Modeling). Introduction to appropriate techniques to model walls, insert fenestration, staircases.

UNIT II

Classroom exercises to convert time problem or works of 2D works of previous semester into 3D project, relationship to other file types (dwg for AutoCAD, .3ds for Sketch up).

UNIT I

Understanding the How, Why and What of Research writing: Choosing a topic, Literature review, conceptualizing the framework, forming the research question, research methods and problem solving. Writing the findings in the form of a report or paper.

UNIT II

Introduction to DE constructivism and 21st Century Architecture: Study the works and philosophies of Architects who defined the style.

UNIT III

UNIT III

Introduction to material library, architectural components such as furniture, joineries, landscape-application of these techniques into 3D project.

UNIT IV

Classroom exercises to convert time problem/works of previous semester into 3D project. Introduction to rendering and visualization-Generating 3d Model and introduction to concepts of visualization using rendering engines.

References:

1. http://designbuildacademy.com/wp-content/uploads/2015/10/REVIT_Walkthrough_getting-Started.pdf
2. http://bimscape.com/beginners-guide-to-revit-architecture/
3. https://www.sdcpublications.com/pdfsample/978-1-58503-812-1-2.pdf
4. http://images.autodesk.com/adsk/files/revit_architecture_2011_user_guide_en.pdf
5. https://www.ace-hellas.gr/wp-content/uploads/2014/10/978-1-58503-973-9-7.pdf

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR607	Landscape Architecture	HC	1	0	1	2	3

Course Objectives:

- To introduce students to the discipline of landscape architecture.
- To develop basic skills required in handling landscape design project.
- To enlighten the students to open space design as an extension of architecture.

COURSE OUTCOMES

1. Outline the importance and significance of landscape and its extent
2. Classify the types of landscape features and varieties.
3. Demonstrate an ability to introduce landscape architecture alongside, as an extension of architecture of the built.
4. Ascertain the pros and cons of proposed or existing landscape of any location.

Course Contents:

UNIT I:

Introduction to landscape architecture and role of Landscape design in built environment. Evolution of concepts in landscape design in integrating built spaces to open spaces

UNIT II:

Landscape elements- Land forms, water and vegetation. Principles of landscape design, and built environment. Selection and management of plant material in relation to built environment, taxonomy and classification of plants. Study and analysis of existing landscaped areas Introduction to study of plant materials in relation to landscape architecture and design. Appearance, functional and visual effects of plants in landscape design Selection and management of plant material in relation to built environment, taxonomy and classification of plants, trees, shrubs

UNIT III:

Site planning and site analysis with reference to different characteristics like topography, vegetation, hydrology, access, surroundings etc. Philosophical and design issues related to site development- spatial and contextual relationships of built and outdoor space and circulation, site and its relationship to surroundings, importance of climate and social factors in development of site.

UNIT IV:

Natural and manmade landscape in urban and rural landscape. Contemporary attitude to development and design of open spaces-like urban spaces, courtyards, gardens, parks, Streetscape, street furniture, pavements and other architectural elements in relation to Landscape design

Studio exercises emphasizing relationship between built form and outdoor areas and site planning issues.

Reference Books:

1) .Blane Alan, Landscape Construction and detailing B T Batsford Ltd, London 1996.
2) Colise Brenda, Land and Landscape.
3) G. Eckbe "Landscape for Living"
4) Trivedi, P. Pratibha, Beautiful Shrubs. Indian Council of Agricultural Research, New Delhi, 1990.
5) Lynch, Kevin, Site Planning, IT Press, Massachusetts, 1962.
6) Laurie, Michael, An introduction to Landscape, II Ed, Prentice Hall, New Jersey, 1986
7).Santapau. H. Common Trees, National Book Trust, NewDelhi, 1981.
8) J.O. Simmonds, "Landscape Architecture"

Course Code	Course Title		L	T	P	Total	Contact Hrs
BR17AR608	Architectural research writing	HC	4	0	0	4	4

Course Objectives:

1. To expose the students to basic research methods in architecture
2. To facilitate the selection, formulation and conduct of a small research exercise related to architecture
3. To familiarize students with basics of academic writing and referencing
4. To cultivate communication skills required to communicate the research outcomes in form of research paper, audio visual/verbal presentations.

Course Outcomes:

On completion of the course, learners will be able to:

1. Demonstrate an understanding of research methods in architecture
2. Explore the realms of their selected topics using primary and secondary research techniques.
3. Acquire skills in academic writing and referencing

Cultivate effective skills to communicate the outcome of the research study

Architectural Research writing:

Students are introduced to the idea of writing research papers in Architecture through self- study.

The course on Architectural criticism attempts to give students an understanding of methods employed in architecture criticism and examine the leading architecture discourses that drives the practice & production of architecture. To learn how to present architecture criticism.

Course Contents:

UNIT I

Understanding the How, Why and What of Research writing: Choosing a topic, Literature review, conceptualizing the framework, forming the research question, research methods and problem solving. Writing the findings in the form of a report or paper.

UNIT II

Introduction to the Architectural Criticism: The need for critical thinking and reasoning in Architecture. The theoretical basis for architecture criticism. Critical discourses in Architecture. The interdisciplinary nature of Architecture theory- power to draw from arts and science. Modes of architectural criticism- Descriptive, Analytical, the influence of different ideologies and power structures on architecture – how architecture influence power structure.

UNIT III

Modes of architectural criticism- Descriptive, Analytical, the influence of different ideologies and power structures on architecture – how architecture influence power structure. Communicating the architectural criticism. Analysis of critical writings in Architecture. The power of rhetorical in criticism. One to one interaction with the Faculty on choosing one specific case study. Defining the abstract and preliminary draft of the paper.

UNIT IV

Presenting a Seminar Paper on any one Critical theory or Architect.

VIVA will be comprising of a combination of Portfolio sheets, sketch book or journal, Paper presentation in the form of a seminar.

All research papers will be published in the form of a book by the School, for documentation purpose.

SEVENTH SEMESTER

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR701	**Architecture Design-VII**	HC	5	0	5	10	10

Studio Theme: Infrastructural Development

Course Objectives:

Students shall get an understanding of increasing demands for functioning sustainable cities.

- To involve students in designing larger projects of higher complexities. An integration of knowledge gained in Construction, Structures, Landscape, Services, Bye laws and codes etc. is required.
- Student to define the design approach at the start of the project, for e.g. sustainable design, Energy Efficient Design, Structural, or any other.
- Designing the un-built environment of Landscape, and applying knowledge of Place making in planning the Public spaces is required.
- Projects can be of the complexity level of Multi- Specialty Hospitals, Transportation Hubs – Bus Terminus, Airports, Metro stations, 5 Star Hotels or resorts.

Course Outcome:

- Explore the possibilities in contextual design
- Relate the materials for functional needs and aesthetics.

Elaborate Space Planning and Integrated Material usage

Course Contents:

UNIT – I

Literature Study and Case Study

Identifying a suitable case study in the City which fits the project brief and doing the study. May be broken up into different components to facilitate group work. Individual Literature studies from available Internet sources and Books to be done.

Site Selection, analysis and Concept development.

UNIT – II

Development of Design

Design developments through study Models, Plans, Sections, area analysis, Mapping with City Bye law's and Zoning. Resolving Vertical services, Firefighting, HVAC and structural systems.

Continuous emphasis on controls, codes and bye-laws.

UNIT – III

Delivery of the Design

Detailed double line Plans, elevations, Sections and models using computer aided software or Manual drawings.

UNIT -IV

Time Problem - Detailed Design of taking one component for ancillary block - e.g. Restaurant / Office/ Hospital Room/ Laboratory.

STUDIO PROJECTS:

Major Project:

Airport design with added infrastructure like shopping, Interactive open spaces etc OR Resort Type Hotels with multiple units and landscaped areas for public interaction, OR Serviced apartment complexes in City Centers with added infrastructure like club, shopping, offices etc.

Time bound problems: They are the effective ways to learn to give quick solutions that can be implemented. It tests the logical ability and presentation skills that are very much required in the real world.

Detailing of a unit within the larger design can be taken up for this.

For eg: Adapting new techniques of roof cover to be applied to a public interactive space, thereby understanding relation between Built and Un-built spaces.

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Reference books:

4. Time savers standards for architectural design data – by John Callender (Editor)
5. Architectural design data – by Ernst Neufert.

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR702	**Professional Practice, Values & Ethics**	HC	1	1	0	2	3

Course Objectives: Students are introduced to

- Outline the Professional responsibilities within the ambit of the laws of the land, building codes, contract documents and ethics.
- Orient to the legal aspects, legislations having a direct impact on Architectural practice.
- Read about tender and contracts.

Course Outcome:

On completion of the course the student will be able to:

- Describe the various aspects of Architectural Practice such as the types of services offered, the scale of fees and stages of payment, types of Architectural firms, types of tenders etc.
- Outline the guiding principles of Professional Practice, including Professional ethics.
- Apply the knowledge learnt through the course into everyday use

Course Contents:

UNIT I:

Introduction to Profession Practice-Idea of profession and essential differences among profession, trade and business. Profession of Architecture-Types and extent of services offered by architects, scale of fees, stages of payment, and contract between client and architect. Code of Professional Conduct-Council of Architecture's guidelines on competitions, types and classifications of competitions. Building Industry-Overview of the industry, Finance, statutory controls, construction procedures and enforcement issues related to building industry and the role of architect, employer, and contractor.

UNIT II:

Architectural Practice1- Types of Architectural firms, proprietorship, partnership, associate ship.
Architectural Practice-2: Various means of building client base and gaining projects.

Tender1& 2 - Procedure of calling for tender, documents necessary, Types of tenders, process of selection and award. Architect's role in tender process, Earnest Money Deposit, Security Deposit, Retention Amount, Mobilization Amount and Bonus & Penalty Clauses.

UNIT III:

Introduction to Contract Administration & Issues of Contract- Bill checking, quality auditing, handover procedures and final certification. Termination of contract, Certificates of value and quality, Defects liability period, Liquidated and un-liquidated damages, Extension of time, delays and penalty, Non tendered items, additional works, variations, rate analysis and architect's role in certification of variations, Types of insurance necessary during contract including fire insurance for safeguarding client's interest. Project formulation - BOT, DBOT, BOLT, BOO.Understand the process - Expression of Interest, Request for proposal, Mode of evaluation, evaluation of Bid, Award of work. Site Supervision, meeting, co-ordination, instructions etc.

UNIT IV

Byelaws, Architect's liability, Legislations and current Trends- Building byelaws, National Building Code, Liabilities - Safeguards in construction industry such as performance bonds, insurance warranties, retention, indemnities, and estoppels and liquidated damages. Legislations - DCR, Factories acts, Heritage Act, TDR, Barrier free environment, CRZ and others

Reference Books:

7. "Professional Practice for Architects & Engineers" By Roshan Namavathi
8. "Legal and Contractual Procedures for Architects" By Bob Greenstreet
9. "Professional Practice" by KG Krishnamurthy and SV Ravindra
10. "Handbook on Professional Practice"By Indian Institute of Architects.

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR703	**Building Services-IV (Acoustics)**	HC	3	0	0	3	3

Course objective:

- To know the properties and characteristics of Sound.
- Outline the science of Acoustics.
- To explore how Open Air Theatres and auditoriums in ancient Rome used the principles of Acoustics in design.
- Calculations and formulae required in Acoustical Design.
- Methods of Achieving Noise control – Natural and Manmade.
- Methods and Materials in Acoustical Insulation.

Course Outcome:

On completion of the course the student will be able to:

- Diagnose the properties and characteristics of Sound.

- Explore the science of Acoustics.
- Figure-out the working principles of open air theatres and auditoriums of ancient period, which worked without the use of modern technology.
- Identify the need of acoustical treatment at various places for absorption, reflection and diffusion
- Acquire the formulae and calculations required in Acoustical Design.
- Adapt the methods of Achieving Noise control by using both Natural and Manmade.
- Acquire the Methods and Materials with different NRC in Acoustical Insulation.

Course Contents:

UNIT I

Introduction to architectural Acoustics - Characteristics and measurements of sound, frequency, intensity, decibel scale, effect of sound on man - design criteria of sound for various architectural spaces, acoustical problems. History behind Theatres and amphitheaters.

UNIT II

Acoustics in built environment - Behavior of sound in enclosed spaces, reverberation and reverberation time, Sabine's formula and its interpretation, dead and live rooms, sound field of classrooms, offices and studios.

Auditorium acoustics - design criteria

UNIT III

Noise Control - Classification of Noise, Environmental impact of noise and acceptable noise levels.Principles of noise control - noise sources, airborne and structure borne sound.

Vibration isolation - damping of noise, noise barriers, noise transmission through ducts, Design criteria for industrial noise control, planning considerations, use of unit absorbers, treatment of floor & wall

UNIT IV

Acoustic materials and applications

General description on properties of acoustical materials – tile, boards, fibers, carpets, resonator absorbers, unit absorbers, composite materials and acoustic plaster, panel absorbers.

Construction details of acoustic treatment on walls, ceiling and floors, floating floor construction acoustic panels and screens, maintenance of acoustic treatment.

References:

4. “Architectural Acoustics Principles and Design”By David R. Johnson and Madan L. Mehta.
5. “Auditorium Acoustics and Architectural Design”By Michael Barron.

6. "McDavid Egan (1988)-Architectural Acoustics" McGraw hill book co., NY.
7. Parich, Peter (1979) Acoustics: Noise and Buildings, Faber and Faber, London

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR704	**Interior Design**	HC	0	1	1	2	3

Course Objectives:

- To familiarize the students with an overview of interior and furniture design and design movements through history.
- To inform the various components of interior space and treatment and finishes for the same.
- To enable students to design an interior project applying all knowledge gained.

Course outcomes:

On completion of the course the student will be able to:

1. Characterize the guiding principles of Interior Design.
2. Enumerate the different components of Interior Design
3. Articulate the integration of lighting, services and landscaping into Interior Design
4. Enumerate the latest finishes and products available in the field of Interior Design and integrate all the above into the final outcome in the form of drawings.

Course Contents:

UNIT – I

History and Introduction - Definition and process of interior design - vocabulary of interior design in terms of principles and elements. Understanding interior spaces using activity analysis and anthropometrics. Effect of enclosure, fenestration, color, lighting on perception of interior space. Psychological effects of space.

Designing for Comfort- natural and artificial lighting, air conditioning and acoustics.

UNIT – II

Components of Interior Spaces

Interior Treatment and Finishes: floors, ceilings, walls, partitions, window treatments, accessories

Furniture Design: Importance of furniture, Ergonomics, Materials, matching Furniture to Themes.

Furniture for specific types of interiors: office furniture, children's furniture, residential furniture.

UNIT – III

Integration into Design - Interior lighting - types of lighting fixtures, Interior landscaping elements: rocks, plants, water, flowers, fountains, paving, artefacts, etc., their physical properties and effects on spaces

Integrating Services into Interior Design: Water supply and drainage, Electrical, Air-conditioning.

UNIT IV

Design of Interiors (Office, Restaurant, Hotel etc.,) - Drawing Plan, Sections, Elevations specifying Materials, methods of construction, detailing showing furniture Layout etc. Should be represented using Manual or Digital software.

References:

1. "Construction and Detailing for Interior Design" By Drew Plunket
2. " Interior Architecture From Brief to Build" By Jennifer Hudson
3. " Key Interiors Since 1900" By Graeme Brooker
4. "Time Saver's Standards for Interior Design", Joseph DeChiara, Julius Panero, Martin Zelnik, McGraw-Hill Professional 2001
5. "Interior Design", John F.Pile, John Wiley and Sons 2004
6. "The Impulse to adorn - Studies in traditional Indian Architecture", Dr.Saranya Doshi, Editor, Marg Publications 1982
7. "Introduction to Interior Design", Steport - De - Van Kness, Logan and Szebely, Macmillan Publishing Co NY 1980.
8. " Human Dimensions and Interior space", Julius Penero and Martin Zelnik, Whitney Library of Design NY 1979

SOFT CORE COURSES

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR7051	**Urban Planning**	SC	3	0	0	3	3

Course Objectives:

- To give an understanding on ancient planning methodologies adopted by the ancient civilizations until the concept of New Towns.
- To impart the importance of planning at a City level.
- To describe various aspects in planning like Land use, Infrastructure, Transportation, Housing, and integrating them at a Town or City level.
- To give an overview of Process of Planning and the implementation mechanism.

Course Outcomes: Students would have developed an understanding of

- Different planning methodologies.
- Planning process and its implementation with respect to the present context.

Course Contents:

UNIT I:

History of Town Planning - Ancient town patterns, Impact of industrialization and technology, Evolution of modern town planning concepts their Characteristics and classification. Model towns, garden cities, satellite towns, suburbia, green belts.Case studies of New Towns.

UNIT II

Planning Principles- National planning, regional planning, and town planning
Principles of land use planning, Principles of environmental planning control of land, water and air pollution.
Planning for Environmental conservation- Ekistics units and grids.

UNIT III

Planning Process and Implementation - Process of preparation of Master plans and developments and development plans - structure plans.Causes for urban blight-remedial planning measures. Housing-concept of L.I.G/ H.I.G and slum clearance boards.

UNIT IV

Planning For Future - Urban Renewal, Re- Planning, Urban Conservation, Concept of Decentralization and Recentralization.
CASE STUDIES- Modern Towns in India /Abroad.

References:

1. “The urban pattern” Arthur Gallion
2. “Garden cities of Tomorrow” Ebenezer Howard
3. “Design of cities” Edmund Bacon
4. “An Introduction to Town and Country Planning”, John Ratcliffe, Hutchinson 1981
5. Urban Planning- theory and practice, Pratap Rao, CBS Publishers.
6. Urban Planning- Anthony J. Catanese, James C. Snyder. McGraw Hill.

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR7052	**Urban Design**	SC	3	0	0	3	3

Course Objectives

- To impart the knowledge about various developments in the field of urban Design.
- To give an overview of urban design as an interface between the fields of architecture and urban planning.
- To describe changing trends due to urbanization and sub-urbanization of cities.

Course Outcomes:

On completion of the course the student will be able to:

- Demonstrate an ability to comprehend the nature of urban design their related problem and create a brief which sets the frame work for design.
- Analyze urban form, size, qualitative and quantitative techniques of assessing requirements and planning amenities.

Course Contents:

UNIT 1

Introduction to Urban design - Discussion on Architecture, Urban Design, and Nature of urban design projects in public and private developments. Urban design guidelines followed during various periods. Characteristics of towns built by Hindu and Muslim Rulers in India.

UNIT 2

Structure of cities- sectors, blocks, streets, squares buildings and open spaces. Elements of Urban Spaces: squares and streets. Role of planning agencies such as development authorities, Urban Arts Commission in the development of cities. Influence of city development policies namely Master plans, zoning regulations on urban Design.

UNIT 3

Urban Design process - Field Study, Identification of area for study.

UNIT 4

Design Proposals, Developments, and urban design guidelines.

References:

6. **Bacon N. Edmund**. Design of cities. Penguin Books, New York 1976.
7. **Krier Rob**, Urban Space 3rdEd, Academy Editions, London 1984.
8. **Mumford Lewis** City in History, Its origin transformation and itsprospects.
9. **Paul Sprelregen Urban Design**: The architecture of Towns and cities
10. **Morris, Anthony, J.E.** History of Urban Form.
11. **Kostof, Spiro,** City Shaped: Urban Patterns and MeaningsThrough History.

VII SEM	ONLINE_OPEN_ELECTIVE	BR17AR7061
DURATION	12 WEEKS	
WEEKLY	2 CLASSES	
NAME OF THE SBJECT	System Design for sustainability	
STARTING OF SESSION	14 SEP 2020	
END OF SESSION	04 Dec 2020	
EXAM DATE	19 DEC 2020	

COURSE NAME: System design for sustainability

COURSE LAYOUT

Week 1: Basics - What is sustainability, sustainable development and why do we need it?
Week 2: Basics - Evolution of sustainability within Design
Week 3: Product Life Cycle Design – Methods & Strategies
Week 4: Product Life Cycle Design – Software Tools
Week 5: Sustainable Product-Service System Design – Definition, Types & Examples
Week 6: Sustainable Product-Service System – Transition Path and Challenges
Week 7: Designing for Sustainable Product-Service System – Methods and Tools
Week 8: Designing for Sustainable Product-Service System – Methods and Tools
Week 9: Designing for Sustainable Product-Service System – Methods and Tools
Week 10: Other Design for Sustainability Tools and approaches
Week 11: Design for Sustainability – Engineering Design Criteria and Guidelines
Week 12: Summary - Connecting the threads

BOOKS AND REFERENCES

Vezzoli, C., Kohtala, C., Srinivasan, A., Xin, L., Fusakul, M., Sateesh, D. and Diehl, J.C.,2017.Product-service system design for sustainability. Routledge. [this is a copy-left bookavailable online] http://www.lens-india.org, http://www.lens-international.org [a copy-left bank of learning resources created by the International Learning Network in Sustainability]

INSTRUCTOR BIO

Prof. Sharmistha Banerjee

IIT Guwahati

harmistha Banerjee is working as Assistant Professor at Department of Design at IIT Guwahati. She did her bachelor in Industrial Design from IIT Guwahati and a master in Integrated Product Design from Technical University of Delft, Netherlands. Her PhD is under progress at IIT Guwahati in the domain of Design for Sustainability applied to agricultural machinery design. She is focused in the area of sustainable product & system development in a collaborative work environment. She has established the Sustainability and Social Innovation Lab alongwith her colleagues at Department of Design which is also part of the International Learning Network on Sustainability, a consortium of more that 150 global universities working in this domain.

SUMMARY

Course Status :	Upcoming
Course Type :	core
Duration :	12 weeks
Start Date :	14 Sep 2020
End Date :	04 Dec 2020
Exam Date :	19 Dec 2020
Enrollment Ends :	21 Sep 2020
Category :	Design Engineering, Product Design
Level :	Postgraduate

This is an AICTE approved FDP course

Course Link: https://swayam.gov.in/nd1_noc20_de07/preview

VII SEM	ONLINE_OPEN_ELECTIVE	BR17AR7062
DURATION	12 WEEKS	
WEEKLY	2 CLASSES	
NAME OF THE SBJECT	Glass in buildings : Design and applications	
STARTING OF SESSION	14 SEP 2020	
END OF SESSION	04 Dec 2020	
EXAM DATE	19 DEC 2020	

COURSE NAME: Glass in buildings : Design and applications

COURSE LAYOUT

Modern Architectural Requirements

- Requirements as per Standards – NBC – Fire & Structural

How to design a Sustainable Building

- Building Physics
- Green Buildings Requirements
- Codal Recommendations – ECBC/IS
- Segment Based Design

Manufacturing of glass

- Types of Glass
- Coating Technology – High Performance Glass
- Innovative Applications – Electrochromic & Digital Printing

Processing

- Tempering/ Double glazing/ Lamination
- Printing on Glass

Glass as Building Envelope Material

- Glass Parameters
- Façade Fundamentals
- Façade Design & Testing
- How to Design Façade for Daylighting & Energy efficiency – Modeling
- Design Tools & Simulation Software's used for Design
- How to understand high performance glass
- Glass for Acoustics, Fire & Interior applications
- Glass for Safety & Security

Case Studies

- On Design & Detailing
- Application Impact
- Building Measurements & its Impact

BOOKS AND REFERENCES

- Structural Glass Facades and Enclosures
- Mic Patterson; Glass in Architecture
- Michael Wigginton; Envelope Design for Buildings
- William Allen; JosephSAmstock's Glass in Construction;

INSTRUCTOR BIO

Prof. K N Satyanarayana

IIT Madras

Prof. E. Rajasekar

IIT Roorkee

Dr. E. Rajasekar is an assistant professor at the Department of Architecture and Planning ,IIT Roorkee, India. He is an Architect with post-graduation in Building Technology and Construction Management and PhD on Thermal comfort and building performance from IIT Madras. He is a Shastri Indo - Canadian Institute Doctoral Fellow.He specializes in the field of building performance assessment focused on the thermal,acoustics and lighting parameters.He carries a rich research and industry experience in this field and has published more than 20 technical papers in peer-reviewed journals and conferences. He is a USGBC LEED accredited professional and a GRIHA certified professional.

SUMMARY

Course Status :	Upcoming
Course Type :	core
Duration :	12 weeks
Start Date :	14 Sep 2020
End Date :	04 Dec 2020

Exam Date :	19 Dec 2020
Enrollment Ends :	21 Sep 2020
Category :	Civil Engineering
Level :	Undergraduate

This is an AICTE approved FDP course

Course link: https://swayam.gov.in/nd1_noc20_ce47/preview

VII SEM	ONLINE_OPEN_ELECTIVE	BR17AR7063
DURATION	12 WEEKS	
WEEKLY	2 CLASSES	
NAME OF THE SBJECT	Integrated Waste Management for a Smart City	
STARTING OF SESSION	14 SEP 2020	
END OF SESSION	04 Dec 2020	
EXAM DATE	20 DEC 2020	

COURSE NAME: Integrated Waste Management for a Smart City

COURSE LAYOUT

Week 1: Introduction to Solid Waste Management
Week 2: Municipal Solid Waste Characteristics and Quantities
Week 3: MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program
Week 4: Municipal Solid Waste Collection, Transportation, Segregation and Processing
Week 5: Disposal of Municipal Solid Waste: Landfill
Week 6: Biochemical Processes and Composting
Week 7: Energy Recovery from Municipal Solid Waste
Week 8: Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country
Week 9: Construction and Demolition (C&D) Waste Management - Overview
Week 10: C&D Waste – Regulation, Beneficial Reuse of C&D Waste Materials
Week 11: Electronic Waste (E-Waste) Management – Issues and Status in India and Globally
Week 12: E-Waste Management Rules 2016 and Management Challenges

BOOKS AND REFERENCES

1) William A Worrell and P. AarneVeslind Solid Waste Engineering, 2nd Edition (SI Edition) Cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)
2) George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill
3) Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization(CPHEEO), India
4) MSW Management Rules 2016, Govt. of India, available online at CPCB website.
5) Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website

INSTRUCTOR BIO

Prof. Brajesh Kumar Dubey

IIT Kharagpur

Professor Brajesh Kr. Dubey has his bachelors degree in Civil Engineering (Hons) from Indian Institute of Technology (IIT) Kharagpur, India and PhD in Environmental Engineering Sciences, University of Florida, Gainesville, Florida, USA. He is presently Associate Professor (Integrated Waste Management and Sustainable Engineering) in the Division of Environmental Engineering and Management at Indian Institute of Technology (IIT), Kharagpur, India. Dr. Dubey has more than 17 years of research, teaching, training and industrial outreach experience in the areas of Integrated Solid and Hazardous Waste Management, and Sustainable Engineering and Application of Life Cycle Assessment techniques. He also works in the area of Life Cycle Analysis and Sustainable Engineering. He has been teaching courses in the area of Solid Waste Management, Hazardous Waste Management, Life Cycle Analysis and Environmental Risk Assessment among other courses for nearly a decade. He has taught at several universities in USA, Canada, New Zealand, China andIndia. He has also conducted training programs in the Integrated Waste Management areas including that for Electronics Waste. Dr. Dubey has authored/co- authored more than 200 publications in his area of expertise and have presented at several national and international conferences. He has worked as Waste Management Expert for UN agencies and World Bank.

SUMMARY

Course Status :	Upcoming
Course Type :	Core
Duration :	12 weeks
Start Date :	14 Sep 2020
End Date :	04 Dec 2020
Exam Date :	Dec 2020
Enrollment Ends :	21 Sep 2020

Category :	Civil Engineering, Environment
Level :	Postgraduate

This is an AICTE approved FDP course

Course Link: https://swayam.gov.in/nd1_noc20_ce43/preview

Course Code	Course Title		L	P	D	Total	Contact Hrs
BR17AR707	**Vacation Assignment/ Study Tour /Summer Course**	HC	0	4	0	2	Vacation time

Course Objectives:

During Vacationsthe students are expected to do retrospection, exploration and recharge their creativity to combat the pressure of the upcoming semester.

Students are encouraged to undertake a study tour in India or International pertaining to Architectural Design Studio, History, Climatology or any other course related to the upcoming semester. The trip will include documentation work that shall be intended to enhance and support classroom learning.

Outside classroom learning can also be encouraged in the form of entrepreneurship initiative and / or development of a business model related to Architecture. For eg: Development of a mobile "Application" that can benefit the public.

Summer course conducted by the University may also be taken up by students and Grades given by the faculty handling the course may be considered for the assessment.

EIGHTH SEMESTER

Course Code	Course Title		L	P	D	Credits	Contact Hrs
BR17AR801	**Professional Training - I**	HC	0	20	4	16	(16 to 18 weeks)

Course objectives:

Practical training under an Architect registered with Council of architecture envisages the following:

- Applying theoretical knowledge in Design problems under the supervision of the Architect in Larger projects
- Preparing working details for actual projects.
- Site Visits to Project sites.

Course Requirements:

- The students of architecture are to undertake a practical training for a period of two semesters under a registered Architect or in the architectural wing/department of an organization with senior Architects in its roll. The organization may be governmental, Private or non- governmental voluntary organizations namely CPED State PWD Department or Board for Urban Planning, and NGO's involved in Housing, Urban development planning, or Environmental Planning under a senior Architect. Training may also be in allied areas namely interior design, Landscape Architecture, Visual design, etc. where a senior architect offers support and training.
- The School shall scrutinize the Credentials of the training organization before permitting any student to take up the internship / practica1 training under that organization.
- All Training organizations are requested to furnish the attendance and progress report every month to the School. A minimum of 80% of attendance at the Office for 20 calendar weeks is required for the students to qualify to register for the next semester.
- After internship and practical training students are to submit the details of work or project in which they have involved. Report shall be submitted in written forms to the School along with a certificate from the employment along with copies of Drawings prepared.
- The School at the end of the semester shall conduct the evaluation of the student's performance and achievement in the form of Viva Voce.

NINTH SEMESTER -2017 BATCH-DETAIL SYLLABUS

No	Course Code	Course Title	Type	L :P : D			Total Credits	Contact Hours	Evaluation
1	BR17AR901	Professional Training – II	HC	0	20	4	16	16 to 18 calendar weeks	SEE VIVA
Total Credits							**16**		

OBJECTIVES

Practical training under an Architect registered with Council of architecture envisages the following:

- To know the general working of an office of an Architect.
- Applying theoretical knowledge in Design problems under the supervision of the Architect.
- Preparing working details for actual projects.
- Training in project management.
- Site Visits to Project sites.

Course Outcomes:

1. Students should come up with process of working of an architect's office.
2. Students must deliver design solutions based on their theoretical knowledge.
3. Able to produce working drawings of projects
4. Capable of handling the projects and managing the same.

REQUIREMENTS

- The students of architecture are to undertake a practical training for a period of two semesters under a registered Architect or in the architectural wing/department of an organization with senior Architects in its roll. The organization may be governmental, Private or non- governmental voluntary organizations namely CPWD State PWD Department or Board for Urban Planning, and NGO's involved in Housing, Urban development planning, or Environmental Planning under a senior Architect. Training may also be in allied areas namely interior design, Landscape Architecture, Visual design, etc. where a senior architect offers support and training.

- The School shall scrutinize the Credentials of the training organization before permitting any student to take up the internship / practica1 training under that organization.
- All Training organizations are requested to furnish the attendance and progress report every month to the School. A minimum of 80% of attendance at the Office for a period of20 Calendar weeks is required for the students to qualify to register for the next semester.
- After internship and practical training students are to submit the details of work or project

in which they have involved. Report shall be submitted in written forms to the School along with a certificate from the employment along with copies of Drawings prepared.

- The School at the end of the semester shall conduct the evaluation of the student's performance and achievement in the form of Viva Voce.

Distribution of Credits shall be as follows: Method of evaluation VIVA in presence of external Jury

S.no	Description	Duration/No of visits	No of credits
1	Training report- to include daily log and weekly reports signed by Office authority	16 to 18 working weeks	10
2	Site learnings and material study report with sketchbook	No of visits	02
3	Hard copy of drawings produced at work	No of drawings	02
4	Materials study/ Office management		02

TENTH SEMESTER -2017 BATCH-DETAIL SYLLABUS

COURSE CODE	COURSE TITLE	L	P	D	TOTAL
BR17ARX100	ARCHITECTURAL DESIGN THESIS	4	0	12	22

Objective:

TheArchitectural Thesis is the culmination of the development of the student's knowledge, attitudes and skills o ver the course of studies in architecture. It is an occasion for exercising conscious choices in the field base don the students' personal abilities and inclinations, and for testing out his commitment. The student, in consultation with the faculty, is expected to demonstrate through an imaginative approach, his expertise in effecting positive changes in our built environment.

Contents:

1. The Thesis shall deal with large built environment project. Work shall be conducted and presented by the individual student in the form of technical report and design drawings. Work shall be comprehensive in nature involving primary data collection, feasibility studies and architectural programming. Large buildings, urban design projects may be taken for the final project/thesis in consultation with faculty.
2. Students are encouraged to pick up live projects.
3. The thesis shall include an area of special interest of relevance, and shall detail its application and design solution. Eg. Interior designs, Services, Socio-economic studies, Structural design, Computer software or images etc.
4. The process for Thesis Project will include – Description, Case Study, Site Study- Analysis & Inferences, Development of specific Design Guidelines; Design Program & Area Requirements, Conceptual Development, Design Development, Final Design, Presentation.

Rules and Regulations – Thesis Submission

- Each individual student in consultation with the guide appointed shall prepare initial synopsis and project plan. The project shall be submitted to the School and the thesis committee appointed by the
- School views the viability of the project. The approved topic shall be taken up by the student for the thesis work.
- Role of the guide is not only to provide academic support and facilitate but also to monitor progress of the work. The guide shall maintain the attendance of his / her student.
- The media of presentation may be unconventional drawing sheets or in digital format with appropriate signature of the school.
- A jury appointed by the School shall evaluate.
- The student has to complete the stage requirements including attending and presenting all the interim reviews in sequence with endorsement of the guide and such will only be allowed to present for the final evaluation by the School appointed jury.

Unit 1

Literature study, case study presentation through drawings and presentations. Site location finalization. The media could be digital or handmade drawings.

Unit 2:

Concept drawings

Unit 3

Design development, arriving at detail built form, site plan

Unit 4

Preparation of report of the project, Final drawings with detailed plans, elevation, sections, 3d views, details of any special aspects like sustainability, acoustics, structural integrity, Landscaping many more associated with architecture.

COURSE CODE	COURSE TITLE	L	P	D	TOTAL
BR17ARX200	CONSTRUCTION MANAGEMENT	1	2	0	3

Objective:

1. To introduce the students to the concept of construction management in the profession.
2. To introduce the students to various techniques of construction project management.
3. To familiarize students with basic computer applications for construction management.
4. To familiarize students with digital media

Ootcomes:

On completion of the course, learners will be able to:

1. Assimilate fundamental knowledge on the theory of construction management and understand the responsibility of the architect as a team player
2. Identify and resolve problems using critical thinking related to project scheduling through case studies
3. Acquire problem solving abilities pertaining to management of projects using different techniques and tools

4. Develop an insight into the application of the required software for construction management

UNIT-1

Concept of Construction Management: Objectives of Construction Management, Historical Background, Relevance and importance of management skills in the present day profession, Players and relationships between them in the building construction industry, Role of Architect in Construction Management, Project life cycle analysis

UNIT-2

Current management system: Scheduling of construction, planning of construction site. Advantages of network Management, network analysis, elements of network, network rules, constraints, errors in network, construction of networks (a simple Building)

UNIT-3

CPM & PERT: CPM: Critical path analysis, Project duration, Construction of CPM Calendar,Activity times and FLOATS, Optimization through CPM Techniques, PERT Technology: PERT ANDThree time estimates, beta distribution curve, Slack in PERT, Critical Path Analysis of a PERT network, Central Limit Theorem, Probability of completion of projects, CPM / PERT: Difference between CPM & PERT, Bar chart versus network, resource allocation and resource leveling, Controlling and monitoring, Updating. Project time, cost and finance management.

UNIT-4

Computer applications of project management: Computer applications of project scheduling and management. Introduction to new trends and research in construction management.

Case studies- Application of knowledge & Understanding of project management tools.

Reference Books:

1. Construction Planning and Management by Dr U.K.Srivastava, Galgotia Publication Pvt Ltd, New Delhi

SOFT CORE COURSES:

Architecture Journalism

COURSE CODE	COURSE TITLE	Type	L	P	D	Total Credits	Contact Hrs.
BR17ARX301	Architecture Journalism	SC	1	2	0	2	3

Course objectives

1.To introduce to the basic structure and principles of architectural journalism
2.To explain the techniques and procedure for conducting architect and client interviews as well as video coverage
3.To illustrate the writing techniques required for architectural journalism and also explain the ethics, laws and legislation
4.To explain the techniques and legal aspects related to editing and publishing

Course outcomes

On completion of the course, learners will be able to:

1.Explore the structure, principles, processes and different mediums of architectural journalism
2.Conduct interviews, shoot videos to create walkthrough of buildings and interview of architects and client
3.Explore the different techniques adhering to the laws and legislations related to design
4. Explore the editing and publishing techniques to create a good layout for the articles related to architecture.

UNIT I

Overview – Definition, Significance, scope, purpose, structure, principles, techniques, processes, mediums, study of potential readers, contemporary architectural journalism.

UNIT II

Environment ,Social Change, Persuasion- Interviewing techniques, Argument and debate as a technique in the investigation of social problems; evidence, proof, refutation, persuasion; training in argumentative speaking. Theories of journalism, Introduction to architectural software's needed in journalism and photography, Video coverage, walkthrough of buildings, production of contemporary architectural journalism. Understanding the individual demands in the context of newspapers, radio, film, and television.

UNIT III

Writing techniques – Styles, format, purpose, medium, frequency, clear structure, coherent & distinctive look, visual appearance, graphic design, genres, image, descriptive & analytical reports.

Ethics, laws & legislations – Plagiarism, Intellectual property rights, Disclaimers, copyright, author's rights, patents & royalties, trade mark, legal boundaries, libel & invasions of privacy, permissions, references & credits

UNIT IV

Editing & Publishing – Proof reading, Editing techniques, Page make up, Layout, color scheme, Font, Abstract, Pictures, Ads ,News, Photo editing - Book previews, Publishing – Print & Electronic.

COURSE OUTCOMES:

On successful completion of this course, students shall be able to

PRODUCT DESIGN

COURSE CODE	COURSE TITLE	Type	L	P	D	Total Credits	Contact Hrs.
BR17ARX302	**PRODUCT DESIGN**	**SC**	**1**	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

- To highlight the Origin, Process and Purpose of Product design.
- To discuss human factors – the influence of ergonomics on product ideation and development.
- To explain the various aspects of product design, emphasizing effective generation and
- development of ideas to new products
- To illustrate the difference between craft based products and mass produced products.

COURSE OUTCOMES:

On successful completion of this course, students shall be able to:

1. Obtain basic skills required in handling simple product design projects.

.
. Analyze the process of creating a new product to be sold by a business to its customers.

3. Handle different stages of product design from concept development, detailing, materiality, technicality and imagebility.

Outline the various aspects, from idea generation to commercialization

COURSE CONTENTS:

Unit 1

Introduction to Product Design:

Various elements – History of Product Design – Definition of Product Design, understanding of Product Design - Purpose of Product Design – Role of Product Designers.

Human factors and Ergonomics:

Definition of human factors, Application of human factors data. Man-machine system and physical environment - Applied anthropometry – User centric Design – Inclusive (Universal) Design – Interaction Design (UI and UX Design)

Unit 2

Aspects of Product Design:

Visual, Auditory, Tactual, Olfactory human mechanisms, Physical space and arrangement. Visual display, process of seeing, visual discrimination, quantitative and qualitative visual display, Alphanumeric and related displays, Visual codes and symbols.

Form, Color, Symbols, User specific criteria, Material, Technology and recyclability, Packaging. Multiple Utility oriented approach to Product Design.cd

Unit 3

Design Thinking Process:

Design philosophies of famous Designers and Brands:

Brands: Alessi, Flos, Dyson, Vitorinox, Olivetti, IKEA, Freitag, Herman Miller, Angle poise, Life straw, Gufram, Driade, Droog.

Designers: Dieter Rams, Philippe Stark, Naoto Fukasawa, Achille Castiglioni, Ettore Sottsass, Fabio Novembre, konstantingrcic.

Unit 4

Empathize, Define, and Ideate, Prototype & Test.

Develop skills to conceptualize, create & market the product based on customer needs.

Exercise: Design of Household elements, tools and devices, Design of furniture, Design of Industrial Products. Element design for the physically and mentally disabled people.

REFERENCES:

1. The Design of Everyday Things by Don Norman
2. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler.
3. Cradle to Cradle: Remaking the way we make things by William McDonough and Michael Braungart.

FACULTY PROFILE

Prof B.S Jagadeesha Chandra, Director of School of Architecture has B Arch degree from University Visvesvaraya College of Engineering, Bangalore University and M Arch (Landscape Architecture) from SPA, New Delhi. Before joining REVA University, Prof. B S Jagadeesha Chandra has served for over 23 years at School of Architecture M S Ramaiah Institute of Technology since its inception. He also served 11 years as Architect at ISRO, Department of Space, Govt. of India. His vision as Head of the School of Architecture has seen its steady growth over the years and today it is one of the most sought after School for studying Architecture.

His total experience of experience, both industrial and academic will definitely benefit the school for its growth and the vision is to make the School a centre of excellence for training the undergraduate students. He has presented papers at National & international conferences. His flair for writing is seen in the articles relating to Architecture & Landscape Architecture in various journals, news papers and magazines. Prof. Jagadeesha Chandra is a registered architect from Council of Architecture.

Prof N.S. Nalini has B Arch degree from BMS College of Engineering, Bangalore and M Tech degree in Geo-informatics from Visvesvaraya Technological University, Belagavi. Currently she is pursuing research leading to PhD degree in urban planning. She has been in the teaching field since 17 years and has an industrial experience of 10 years. She has taught both undergraduate and post graduate students in various colleges. She has published research and news paper articles and has presented several papers in national and international conferences. She is a registered architect from Council of Architecture.

Dr. Vimala Swamy
Professor

Dr. Vimala Swamy, has experience in numerous facets of Architecture, urban planning, landscape and interior design. She has balanced Academics, Practice and Research work in her career with over 20 publications in various International and National conferences and journals in topics of Modified Landuse Patterns, Solar Passive Architecture and Sustainability. Her Doctoral thesis focuses on Eco-Friendly Cities, which is the current worldwideissue. Dr. Vimala is a registered guide with VTU and has fourPh.D. Scholars pursuing their research under her guidance. She is also on the Board of studies for the School of Planning & Architecture, University of Mysore. She received the 'Best Teacher' award from A3 Foundation, Chandigarh in 2016. Her vast experience and vision will undoubtedly take this young school towards success and growth.

Ar. Rajesh Malik
Professor - Design Chair

Architect Rajesh Malik is an Architect and academician with a passion for sustainable design, well recognized as the need of the hour. In the course of his career spanning more thantwo decades, he has handled a diverse range of projects, ranging from prestigious residential developments to I.T buildings and Hotels through different stages of Design and Execution. His area of research is Sustainable construction and materials and has published and presentedat National and International conferences. Architect Rajesh heads the design consultation cell at the School and contributes immensely to the advanced Design studio and related courses.

Ar. Paul George Puthoor
Professor

Ar. Paul Puthoor has a Bachelor's degree from Bangalore University in 1979. He has an established practice in Bangalore, 'Spaces' since four decades. An unconventional thinker, his domain of work has been towards Industrial Architecture and Residential design. Having designed hundreds of residences all over South India, he was chosen for the Best Residential Project award in 2014 in Kerala.Young students of Architecture benefit immensely from his vast knowledge and command over the Profession in courses like Building Construction and Materials and the Design Studio.

Ar. Vidya Srikanth

Associate Professor

Ar. Vidya Srikanth has an architectural degree from National Institute of Technology, Tiruchirappalli and a Masters in Town and Country Planning from School of Architecture and Planning, Anna University. She has over 16 years of combined experience in teaching and practice. She is widely travelled and brings with her rich experiences of living and working in Europe and North America. She is closely associated with the Curriculum design of the B. Arch program and is member coordinator of the Board of Studies for the School.She is passionate about Vernacular Architecture and is involved with documenting and researching the local Vernacular techniques in Karnataka. With a deep interest in Architectural Pedagogy, Vidya initiates and practices several innovations in course delivery and evaluation methods and her publications are rooted in the same themes.

Ar. Shubhi Sonal

Associate Professor

Ar. Shubhi Sonal is an Urban Planner-Architect with varied research interests in the field of urban planning and housing. She is registered as a doctoral candidate with JNAFAU, Hyderabad. Shubhi graduated from School of Planning and Architecture, New Delhi and completed Master's Degree in City Planning at Indian Institute of Technology, Kharagpur. In a career spanning over 8 years, she has worked with both Multi-National firms and public agencies dealing with architecture and urban planning projects. She has published and presented papers at many conferences in India and abroad. At the School Shubhi is associated with the Research and Training wing and teaches courses in History, Housing and Design, while bringing in fresh approaches in the Pedagogy.

Ar. Kokila Mohan

Associate Professor

Ar. Kokila Mohan is an Architect & Urban Designer, graduating from Visveswaraya Technological University, India with over 8 years of professional and academic experience in transportation infrastructural projects which includes Inception to execution for Bangalore metro rail, Kolkata metro station depot, Doha road infrastructure, Landscape and urban design project a vision for Doha's 2020 master plan. She has been actively involved in the heritage walk programs conducted for Indian National Trust for Art and Cultural Heritage (INTACH) and is recognized as a walk leader for India Foundation for Arts (IFA) to explore the relationship betweenart and lived spaces of the neighborhood. Kokila is actively involved withthe Schools' social media presence and website and has helped release 'Incipere', the first ever Publication from the School in 2018.

Ar. Neeraja Jayan

Assistant Professor

Ar. Neeraja Jayan, has B Arch degree with 4th Rank from Satyabhama University and **M Arch** degree in Architectural Conservation from **School of Planning and Architecture, NewDelhi**. She has been in the teaching field since 3 years and has an industrial experience of 1 year. She has taught undergraduate students in various colleges. She has received the best paper presentation award for her paper in Architectural Journalism. She is a registered architect from Council of Architecture.

Ar. Raghu Teja Vemana

Assistant Professor

Ar. Raghu Teja Vemanahas a Bachelor of Architecture degree from JNAFAU, Hyderabad. He has four years of experience in the field of construction having worked at renowned firms in Chandigarh and Hyderabad. He completed his Master's degree in Urban Planning from university of Mysore with distinction. He has over four years of teaching experience as a full-time faculty and is currently pursuing his Doctorate in the field of Urban and Regional planning from University of Mysore. Raghuteja has published and presented at many National conferences in his area of research on Urban issues.

Ar. Deepa Rajesh Negali

Assistant Professor

Ar. Deepa Rajesh Negali has a Bachelor's degree from Karnataka University, Dharwad (BVB college of Engineering & Technology, Hubli). She has been in academics for over 4 years and has an industrial experience of one year. The best teacher award shereceived in 2015 shows her passion towards Academics and her ability to connect with students. Her area of interest is Building Construction and Building services and Deepa keeps herself updated by attending conferences and Faculty development programs in this domain.

Ar. Sneha Murthy

Assistant Professor

Ar. Sneha Murthy has a Bachelor's degree from MSRIT, Bangalore with a merit rank from VTU. She has been in practice and has an industrial experience of over 8 years. Her passion towards sharing her knowledge in the field and interacting with students led her towards academics in 2016. With a deep interest in Energy efficient Design, she is an Indian Green Building Council (IGBC) Accredited Professional. At the University, she is associated with the Entrepreneurship and skill development cell and won the award for 'best entrepreneur trainer' in 2018. She is keenly involved with guiding students in Design Competitions. Sneha teaches courses in Climate Responsive Architecture, Design, Building Construction & Building Services.

Ar. Anupama Ajit
Assistant Professor

Anupama Ajit has completed her Bachelor of Architecture from RV College of Architecture, Bangalore. She has over 6 years ofexperience working in Bangalore and in Tokyo, Japan. She has a deep interest in travel and finds that it enriches the course delivery in courses like Theory of Design, History and Contemporary architecture. She has worked on Infrastructure projects for BMRCL and BBMP in Bangalore.

Ar. RuhiDixit has B Arch degree from Bangalore University (UVCE) and **M S**(Master of Construction and Project management) degree from**University of Edinborough, England**. She has a rich industrial experience as Architect at DivyaSree Developers. She has involved in the design of many major projects of DivyaSree. She is a registered architect from Council of Architecture.

Ar. Jayaram K has B Arch degree from Bangalore University in 1976 and is currently practicing as Architect in Bangalore. He has been in the teaching field since 20 years and has an industrial experience of 39 years. He has taught undergraduate students at MSRIT and UVCE. He has the honour of building a mobile house and it was shifted from Rajajinagar to Chandra Layout. He is also very active in Architectural Journalism and regularly and writesfor Times of India, Deccan Herald, Prajavani, Udayavani and others. He is a registered architect from Council of Architecture.

Ramesh Katti is a reputed artist. He has his graduation from Karnataka Arts and Visual Academy (KAVA), Mysore in 1999 and Post Graduation from M.D. Shantiniketan, Calcutta in 2006. **Ramesh Katti** is a practicing Artist. He has been in the teaching field since 10 years. He has taught undergraduate students at various colleges and conducted many workshops for students of architecture and art.

Eashwar Reddy, possesses Degree in Civil Engineering from S J C Institute of Technology, Chickaballapur and M.E in Earthquake Engineering from University Visvesvaraya College of Engineering, Bangalore. He has served at MNC Gammon India Limited, Rathangiri as Assistant Engineer, and Assistant Professor at Nagarjuna College of Engineering, Bangalore and Acharya Institute of Technology.

Dr. RajashekarPatil BE, M Tech and Ph.D. in Mechanical Engineering. He also possesses PGDBM and PGDNBT. He has published 25 research papers in refereed national and international journals and 07 books in the area of Engineering Drawing & Machine Drawing. He has been honoured with the GLOBAL ENGINEERING EDUCATION LEADERSHIP AWARD from SIEMENS, 2010, Platinum Jubilee Award by Institute of Engineers, Bangalore, on the occasion of 150th Birthday of Sir M. Visvesvaraya and Received Margadarshan Award for Innovation and Excellence in Training, 2013 by IIT, Delhi. Dr. RajashekarPatilserved 05 years in Visvesvaraya Technological University as a Special Officer at VTU, wherein he initiated computer aided engineering drawing and computer aided machine drawing and served as key resource person in training the faculty. He also contributed for establishing Design and Development Lab (Rapid Prototyping Lab) at VTU. His areas of specialization and research are CAD & CAM, Robotics, Rapid Prototyping, CAED, CAMD and Collaborativeand Digital Manufacturing. He has successfully guided 26 researchers for M. Tech degrees. He has been trained by Bosch-Rexroth, at Lohr, Germany on Hydraulics and Pneumatics & isan Accredited Trainer. At present he is guiding 05 PhD scholars.

Dr. C. Chamundeshwari, School of Arts & Humanities, holds a Ph.D. in ‘English Language Teaching’ from Anna University, Chennai. Her doctoral thesis focused on ‘A Study on Computer Assisted Language Learning’, M.Phil. in Sociology (Bharathidasan University), M.A. Degree in English Literature (Annamalai University), and M.A. Degree in Sociology (Mysore University). She has 14 years of teaching experience and One year of Industrial Experience. She has published 4 papers in international journals and presented 6 papers in International Conference/ Seminar/ Proceedings and one paper in the National Conference. Her areas of interest include: English Language Teaching (ELT) and Computer Assisted Language Learning (CALL).

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Center on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbours.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

Note: 1. Rules are revised / reviewed as and when required.

2. Healthy suggestions are welcome for betterment of Institution

10 YEARS OF UNIVERSITY RECOGNITION
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Bengaluru, India

School of CSA

Master of Science in Computer Science (MS-CS)

HANDBOOK
2017-2018

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SCHOOL OF COMPUTER SCIENCE AND APPLICATIONS

M.S. Computer Science

HAND BOOK

Rukmini Educational Charitable Trust

OUR VISION

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

OUR MISSION

1. To create excellent infrastructure facilities and state- of- the -art laboratories and incubation centers .
2. To provide student-centric learning environment through innovative pedagogy and educational reforms.
3. To encourage research and entrepreneurship through collaborations and extension activities.
4. To promote industry-institute partnerships and share knowledge for innovation and development.
5. To organize social development programs for knowledge enhancement in thrust areas.
6. To enhance leadership qualities among youth, to enrich personality traits and promote patriotism and moral values;

BROAD OBJECTIVES

1. Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines.
2. Smooth transition from teacher - centric focus to learner - centric processes and activities.
3. Performing all the functions of interest to its major constituents like faculty, staff, students and society to reach leadership positions.
4. Developing a sense of ethics in the University community, making it conscious of its obligations to society and the nation.
5. Accepting the challenges of globalization to offer high quality education and other services in a competitive manner.

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
2. Be regular and punctual to classes
3. Study regularly and submit assignments on time
4. Be respectful to your Teaches/friends and hostel staff/management.
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Bengaluru, India

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MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju
Chancellor
REVA University

"Education is the most powerful weapon which you can use to change the world."
- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I'm always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambi- ence in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said 'A University should be a place of light, of liberty and of learning'. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the bud- ding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of educa- tion" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavour to provide pre- mium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS". Welcome to the portals of REVA University

Dr.S. Y. Kulkarni

Vice-Chancellor REVA University

Director –Message

It's my pleasure to welcome you to the School of Computer Science and Applications. Computer, being considered as most significant and revolutionary invention of mankind has metamorphosed the planet earth completely. Predominantly School of Computer Science and Applications have acquired the control of the modern life in a myriad way.

The MS (Computer Science) program is designed keeping in view the current situation and possible future developments, both at national and global levels. This program is designed to give greater emphasis on computer science. There are ample number of courses providing knowledge in specialized areas of network security, python programming and cloud computing etc. facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts in computer applications.

The program is designed to expose students to various subjects having applications in computers, IT and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

The benefits of choosing MS (Computer Science) program are:

- Flexibility to choose various fields upon graduation.
- Opportunity to work on live problems.
- Opportunity to work on environmental related technologies.
- Opportunity for programmers to develop software for varied applications in different sectors.

Students after successful completion of MS (Computer Science) program:

- Can start-up their career in either government sector or private sector since there are ample employment opportunities in these sectors.
- Can also start their career as software programmers / engineers, testing engineers, data base administers, system and network administrators, multimedia / web programmers, web designers etc.,
- Can seek placements in diversified fields like banking, e-commerce, insurance, entertainment, and such others.
- The computer application trained graduates are sought after by varied firms for their software based skills.
- Can opt for higher studies in computer science, IT, business management and so on.

The curriculum caters to and has relevence to local, reginal, natinal and global development needs. All courses are focussed on building skill, employability and entrepreneurship of students. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

I am sure the students choosing MS (Computer Science) in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students pleasant stay in REVA and grand success in their career.

Dr. S. Senthil

Director – School of Computer Science and Applications

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Commerce, Education, Engineering, Environmental Science, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Engineering, Commerce, Management, Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notch educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 14,000 students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and conductive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27th February, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 12000+ students studying in various branches of knowledge at graduate and post graduate level and 302 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano-Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by

NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Oklahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is 'Life Time Achievement Award' to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the “Founders’ Day Celebration” of REVA University in presence of dignitaries, faculty members and students gathering and the first “REVA Life Time Achievement Award” for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO on the occasion of Founder’s Day Celebration, 6th January, 2016 and the second “REVA Life Time Achievement Award” for the year 2016 has been awarded to Shri. Shekhar Gupta, Renowned Journalist on the occasion of Founder’s Day Celebration, 6th January, 2017.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organises yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honors and recognitions.

SCHOOL OF COMPUTER SCIENCE AND APPLICATIONS

The School of Computer Science and Applications is equipped with highly qualified and experienced faculty members. The school has the state-of-the-art class rooms and advanced computer laboratory. The School offers BCA, B.Sc (Honors), MCA and MS (Computer Science) programs. The School also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry oriented. These programs provide ample scope to enter into a wide range of business opportunities. This is reflected in various core subjects / courses offered within the program.

VISION

To transform students into good human beings, responsible citizens and competent professionals, focusing on assimilation, generation and dissemination of knowledge in the area of Computer Applications

MISSION

- To impart quality education to meet the needs of profession and society, and achieve excellence in teaching-learning and research in the area of Computer Applications;

- To attract and develop talented and committed human resource, and provide an environment conducive to innovation, creativity, team-spirit and entrepreneurial leadership in Computing field;

- To facilitate effective interactions among faculty and students of the School of Computer Applications, and foster networking with alumni, industries, institutions and other stake-holders; and

- To practice and promote high standards of professional ethics, transparency and accountability.

OBJECTIVES

- To impart course and programs at graduate, post-graduate and doctorate levels in the field of computer applications;

- To adopt innovative methods of teaching and promote student centric learning process;

- To create infrastructure of international standard and facilitate and create conducive environment for teaching, learning and research;

- To promote faculty development and encourage faculty members and students to organize and participate in national and international level conferences, seminars, symposia and such others;

- To encourage teachers and students to take-up interdisciplinary studies and research;
- To promote students participation in co-curricular and extension activities and develop their personality traits and team spirit.

VALUES

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Team-work

M.S. Computer Science
Specialization in Data Science and Analytics

Program Objectives:

The Post Graduate / Under Graduate in Computer Science and Applications from REVA University after 3 - 5 years completion of the programme shall:

- Demonstrate as a successful Software Professional with INNOVATIVE SKILLS, MORAL and ETHICAL VALUES.
- Engage in life-long learning through RESEARCH and Professional development.
- Serve as a LEADER in the profession through consultancy, extension activities, RESEARCH and Entrepreneurship.

Program Outcomes:

a) Able to apply knowledge of mathematical, scientific, and computer science to evaluate, analyze, synthesize, model and integrate technologies to develop new computer system for applied systems.

b) Analyze complex problems critically related to Computer Science domain, apply independent judgment for synthesizing information to make intellectual and/or creative advances with a research perspective.

c) An ability to work upon unfamiliar problems through investigative studies and research and contribute to the development of technological knowledge and intellectual property.

d) Function on multidisciplinary teams with positive attitude.

e) Identify, formulate, and solve problems in accordance with the relevant standard codes of practice.

f) Apply knowledge of research methodologies in their disciplines and capacity to interpret findings.

g) Recognize the need for, and an ability to engage in life-long learning.

h) Understand contemporary issues in providing technology solutions for sustainable development considering impact on economic, social, political, and global issues and thereby contribute to the welfare of the society.

i) Understand the role of Software developers and ethical responsibility.

j) Communicate effectively through verbal, written and graphical modes.

ADVISORY BOARD

SL. No	NAME
1	Dr. Anand Kumar Professor and Dean-Academics, MCA Department, M.S Engineering College
2	Dr. Muralidhar B.L Professor and Coordinator, MCA Programme, Bangalore University
3	Dr. Dharani Dhamre Professor, Dept of MCA, RVCE
4	Mr. Manikantan Mohanavelu Head Training Tower-India, HP
5	Mr. Madusudan R Practice Lead, Engagement & System Operations-IBM
6	Mr. Dharshan Maheshbhai Project Lead- Cognizant Technology Pvt Ltd
7	Mr. Ashish Tanwar, University Relations Manager-India, Dell

"Education is the manifestation of the perfection already in man"

- ***Swami Vivekananda***

"The real danger is not that computers will begin to think like men, but that men will begin to think like computers."

- ***Sydney J. Harris***

"People think computers will keep them from making mistakes. They're wrong. With computers you make mistakes faster."

- ***Adam Osborne***

The ladder of success is best climbed by stepping on the rungs of opportunity.

- ***Ayn Rand***

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0. A course shall have either or all the three components. That means a course may have only lecture component, or only practical component or combination of any two or all the three components.

2.1. Various course of s**tudy** are labeled and defined as: (i) Core Course (CC) (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Foundation Course (FC):**

The foundation Course is a core course which should be completed successfully as a part of graduate degree program irrespective of the branch of study.

(iii) **Hard Core Course (HC):**

The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iv) **Soft Core Course (SC):**

A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(v) O**pen Elective Course:**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **Six to Eight credits** is called **Minor Project** work. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE, SIXTEEN or TWENTY** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be earned:

3.1. A candidate has to earn 96 credits for successful completion of M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 32 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 96 credits for the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics). The A**dd -on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5. Scheme of Assessment & Evaluation

5.1. The Scheme of Assessment and Evaluation will have **TWO PARTS**, namely;

i. Internal Assessment (IA); and
ii. Semester End Examination (SEE)

5.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of PG programs shall carry 50 marks each (i.e., 50 marks internal assessment; 50 marks semester end examination).

5.3. The 50 marks of Internal Assessment (IA) shall comprise of:

Internal Test	= 30 marks
Assignments	= 10 marks
Seminars	= 10 marks

5.4. There shall be **three internal tests** conducted as per the schedule given below. T**he students have to attend all the three tests compulsorily.**

- **1st test** for 15 marks during **2nd part of the 6th week** of the beginning of the Semester;
- **2nd test** for 15 marks during **2nd part of the 13th week** of the beginning of the Semester; and
- **3rd test** for 15 marks during **2nd part of the 16th week** of the beginning of the Semester.

5.5. The coverage of syllabus for the said three tests shall be as under:

- For the **1st test** the syllabus shall be **First Unit and 1st half of Second Unit** of the Course;
- For the **2nd test** it shall be **Second half of Second Unit and Third Unit** of the Course;
- For the **3rd test** the syllabus will be **Fourth Unit** of the Course.

5.6. **Out of 3 tests, the highest marks secured in two tests are automatically considered while assessing the performance of the students.**

5.7. There shall be two Assignments and two Seminars each carrying 5 marks. Hence two assignments carry 10 marks (5+5 marks) and two seminars carry 10 marks (5+5 marks) as stated at Sl.No.5.3 above. In place of assignments and seminars, there shall be model designs or some task based activity wherein the number of designs/ activity the marks each design / activity carries shall be decided by the respective School Board. However such decision shall be done well in advance and it should be announced before commencement of the Semester after communicating the same to the Registrar and Registrar (Evaluation) to avoid ambiguity and confusion among students and faculty members.

5.8. The Semester End Examination for 50 marks shall be held during 19th and 20th week of the beginning of the semester and **the syllabus for the semester end examination shall be entire 4 units**.

5.9. The **duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.**

5.10. There shall be double evaluation, viz, first valuation by the internal teachers who have taught the subject and second evaluation shall be the external examiner.

5.11. The average of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results.

Summary of Continuous Assessment and Evaluation Schedule

Type of Assessment	Period	Syllabus	Marks	Activity
Allocation of Topics for Assignments / Seminars / Model Design	Beginning of 5th Week	First Unit and Second Unit		Instructional process and Continuous Assessment
First Internal Test	Second Part of 6th Week	First Unit and 1st half of Second Unit	15	Consolidation of First Unit and 1st half of Second Unit
Submission of Assignments/ Model Design	8th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Seminars	9th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2nd Part of 13th Week	2nd half of Second Unit and Third Unit	15	Consolidation of 2nd half of Second Unit and Third Unit
Allocation of Topic for 2nd Assignment / Seminars	11th Week	Third Unit and Fourth Unit		Instructional process and Continuous Assessment
Submission of Assignments/ Model Design	13th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Seminars	14th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment

Third Internal Test	2nd Part of 16th Week	Fourth Unit	15	Consolidation of entire Fourth Unit
Semester End Practical Examination	17th & 18th Week	Entire Syllabus	50	Conduct of Semester - end Practical Exams
Preparation for Semester–End Exam	17th & 18th Week	Entire Syllabus		Revision and preparation for semester–end exam
Semester End Theory Examination	19th and 20th Week	Entire Syllabus	50	Evaluation and Tabulation
	End of 21st Week			Notification of Final Grades

Note:

1. **As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and confusion.*

2. *Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.*

3. *Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.*

6. Assessment of Performance in Practicals

6.1. The performance in the practice tasks / experiments shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting

6.2. The 50 marks meant for continuous assessment of the performance in carrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	**50 marks**

6.3. The 50 marks meant for Semester End Examination, shall be allocated as under:

i	Conduction of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	**50 marks**

6.4. The duration for semester-end practical examination shall be decided by the concerned School Board.

7. Evaluation of Minor Project / Major Project / Dissertation:

Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation. The components of evaluation are as follows:

i	Periodic Progress and Progress Reports (25%)
ii	Results of Work and Draft Report (25%)
iii	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

8. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components (Mid-term Tests and Assignments), he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of respective semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cell is final.

For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener
- One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member.
- One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member

9.0 Eligibility to Appear for Semester - end Examination.

Only those students who fulfill a minimum of 75% of attendance in aggregate of all courses including practical courses / field visits etc, as part of the program shall be eligible to appear for Semester End Examination.

10. Requirements to Pass a Course / Semester and Provision to Drop / withdraw Course

10.1 **Requirements to Pass a Course**

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 + SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (12 marks) in Semester End Examination (SEE) which is compulsory.

10.2. **Requirements to Pass a Semester**

To pass the semester, a candidate has to secure minimum of 40% marks in each subject / course of study prescribed in that semester.

10.3. **Provision to Carry Forward the Failed Subjects / Courses:**

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, he / she shall have to clear all courses of all semesters within the double duration, i. e., within **four years** of admission of the first semester failing which the student has to re-register to the entire program.

10.4. **Provision to Withdraw Course:**

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is Soft Core Course or Open Elective Course.

A DROPPED course is automatically considered as a course withdrawn.

1. Re-Registration and Re-Admission:

11.1. A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for Semester End Examination (SEE) shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

11.2 In such a case where in a candidate drops all the courses in a semester due to personal reasons, it is considered that the candidate has dropped the semester and he / she shall seek re-admission to such dropped semester.

2. **Attendance Requirement:**

a. All students must attend every lecture, tutorial and practical classes.

b. In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.

c. Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (SEE) examination.

d. Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of SEE, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of SEE examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

e. **Absence during Internal Test:**

In case a student has been absent from a internal test due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for conducting a separate internal test. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

3. **The Grade and the Grade Point:**

The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	Grade G	Grade Point (GP=V x G)	Letter Grade
90 >100	10	v*10	O
80 > 90	9	v*9	A+
70 > 80	8	v*8	A
60 > 70	7	v*7	B+
55 > 60	6	v*6	B
50 > 55	5.5	V*5.5	C+
40 > 50	5	v*5	C
0-40	0	v*0	F
ABSENT			AB

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[IA + SEE]) secured by a candidate in a course which is **rounded to nearest integer**. V is the credit value of course. G is the grade and GP is the grade point.

4. **Provisional Grade Card:**
The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA). This statement will not contain the list of DROPPED / WITHDRAWN courses.

14.1 Computation of SGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = ∑(Ci x Gi) / ∑Ci** where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4X9=36
Course 2	4	O	10	4X10=40
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	A	8	3X8=24
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			205

Thus, **SGPA = 205 ÷ 24 = 8.54**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4X10=40
Course 2	4	A+	9	4X9=36
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18

Course 6	3	A	8	3X8=24
Course 7	2	B+	7	2X7=14
Course 8	2	O	10	2X10=20
	24			200

Thus, **SGPA = 200 ÷ 24 = 8.33**

15. **Challenge Valuation:**

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the Grade awarded to him/her by surrendering the Grade Card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 10 days after the announcement of the results. **This challenge valuation is only for Semester End Examination (SEE) component.**

b. The answer scripts for which challenge valuation is sought for shall be evaluated by another external examiner (third examiner) who has not involved in the first evaluation. The higher of two marks from the average of first two valuations and challenge valuation shall be the final.

16. Final Grade Card:

Upon successful completion of M.S in Computer Science / M.S in Computer Science with Specialization in Data Science and Analytics degree a Final Grade card consisting of Grades / CGPA of all courses successfully completed by the candidate shall be issued by the Registrar (Evaluation).

16.1. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for M.S in Computer Science / M.S in Computer Science with Specialization in Data Science and Analytics degree is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = $\sum(C_i \times S_i) / \sum C_i$ Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 = 204.96
3	24	9.35	24x9.35 = 224.4
4	24	9.50	24x9.50 = 228.0
Cumulative	96		857.28

Thus, **CGPA** = $\frac{24x8.33+24x8.54+24x9.35+24x9.50}{96} = 8.93$

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.93 x 10=89.30

17. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

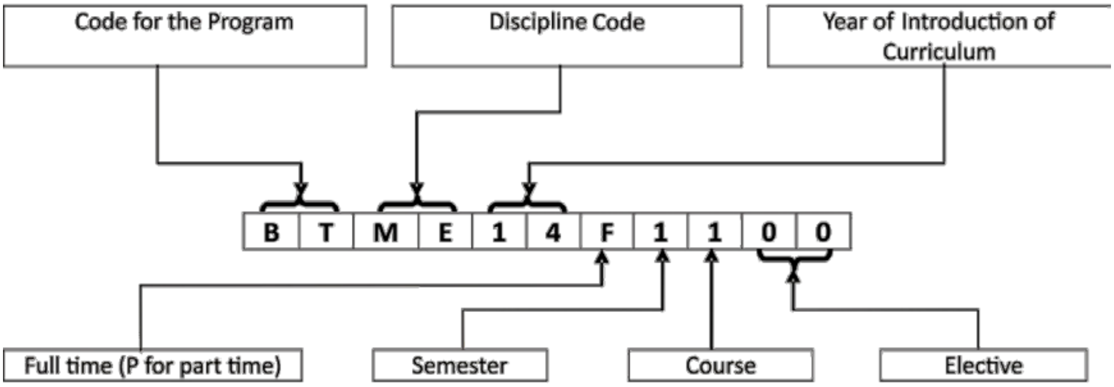
CGPA	**Grade (Numerical Index)**	**Letter Grade**	**Performance**	**FGP**
	G			**Qualitative Index**
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass

.

Overall percentage=10*CGPA

18. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice-Chancellor shall be final.

COURSE NUMBERING SCHEME



List of Codes for Programs and Disciplines / Branch of Study

Program Code	Title of the Program	Discipline Code	Name of the Discipline / Branch of Study
BA	Bachelor of Arts	AE	Advanced Embedded Systems
BB	BBA (Bachelor of Business Administration)	AI	Advanced Information Technology
BC	B.Com (Bachelor of Commerce)	AP	Advanced Power Electronics
BR	B. Arch (Bachelor of Architecture)	CA	Computer Aided Structural Engineering
BS	B Sc, (Bachelor of Science)	CE	Civil Engineering
BT	B.Tech (Bachelor of Technology)	CH	Chemistry
BP	Bachelor of Computer Applications	CO	Commerce
BL	LLB (Bachelor of Law)	CS	Computer Science and Engineering / Computer Science
MA	Master of Arts	DE	Data Engineering and Cloud Computing
MB	MBA (Master of Business administration)	EC	Electronics and Communication Engineering
MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MP	Master of Computer Applications	EE	Electrical & Electronics Engineering
		AL	Computer Application

M.S. Computer Science
Specialization in Data Science and Analytics Program

Programme Overview

Computers have become ubiquitous part of modern life, and new applications are introduced every day. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse. Since 2001, global information and communication technologies (ICTs) have become more powerful, more accessible, and more widespread. They are now pivotal in enhancing competitiveness, enabling development, and bringing progress to all levels of society.

The career opportUNITies for Master of Science in computer science graduates are plenty and growing. Programming and software development, Information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the areas where the graduates find opportUNITies.

The School of Computer Science and Applications at REVA UNIVERSITY is offering Master of Science in Computer Science (MS) –a two year postgraduate programme. The aim of the programme is to create motivated, innovative, creative thinking graduates to fill in the roles of Software Engineers who can conceptualize, design, analyze and develop computer software to meet the modern day industry requirements.

This MS programme in Computer Science is offered by **School of Computer Science and Applications at REVA UNIVERSITY in collaboration with University of Alabama in Huntsville (UAH), USA. The students of this programme who completes first year of study successfully at REVA University has a choice either to pursue their second year of study at UAH or continue in REVA.**

The programme is designed to develop human resources to meet the challenges of ever-growing technologically advanced IT industry and digital revolution. The programme deals with important present day topics like data analytics; information security; Data warehousing and Data mining; mobile application development and cloud computing.

Programme Educational Objectives (PEOs)

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of Computer Science; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of ICT industry, academics, research establishments or take up entrepreneurial route.

Program Educational Objectives (PEO's)

The programme educational objective of the Master of Science in Computer Science of REVA University is to prepare graduates

The Programme Educational Objectives are to prepare the students to:

PEO-1	Be skilled Computer Application Developers, Use existing algorithms to develop computer applications, Provide computer based solutions for real life problems, Design, develop and test software /computer applications for specific needs
PEO-2	Understand the concepts and theories behind computer science and Adapt to the upcoming trends and technologies to the level of developing of commercially viable, robust and reliable software by ensuring that projects are completed satisfactorily, on time, and within budget ,
PEO-3	Work as a member of a team and communicate effectively across team members, to be equipped to be competent in the field of computer science and be equipped to act as a business administrators or as administrators in public, private and government organisations or become an entrepreneur.
PEO-4	understand environmental, legal, cultural, social, ethical, public safety issues work along with engineering, medical, ICT professionals and scientists to assist them in their research and development work after further training

Program Outcomes (POs)

PO 1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of computer science that form a part of the graduate programme Master of Science in Computer Science

PO 2: Scientific reasoning: Ability to analyse, and understand concepts in computer science, and explain the theories behind computer science. critically evaluate ideas, logical reasoning and experiences in programming, software development and application development.

PO 3: Problem solving: Capacity to extrapolate and apply competencies to solve different kinds of non-familiar problems, such as solving of real life problems through computing, provide Solutions to computing problems, analyze existing algorithms of different applications, design and develop new algorithms, operate various commercial software tools to solve scientific and business problems

PO 4: Environment and Sustainability: Understand the issues of environmental contexts and **sustainable development and provide solutions for the same using domain knowledge in Computer science.**

PO 5: Research-related skills: Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation in current technologies.

PO 6: Ethics: Conduct as a responsible citizen by recognizing different value systems and understand and **accept responsibility of** the **moral dimensions and take** decisions which conform to cultural, environmental, sustainability and ethical issues for them.

PO 7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

PO 8: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups

PO 9: Self-directed and Life-long Learning: Acquire the ability to engage in independent and **life-long learning** in the broadest context socio-technological changes.

Programme Specific Outcomes (PSO)

After successful completion of the programme, the graduates will be able to

1. Apply the latest trends in technology to design, develop and test software applications for specific needs.
2. Explore the concepts and theories behind computer science to develop innovative software applications.
3. Instill life-long learning skills through the development of a research environment and higher educational opportunities

MS in Computer Science

(With Specialization in Data Science and Analytics)

SCHEME OF INSTRUCTION

FIRST SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS101	Multivariable Calculus	HC	3	1	0	4	5
2.	MS17CS102	Object Oriented Programming with JAVA	HC	3	0	1	4	5
3.	MS17CS103	Data Mining and Knowledge Discovery	HC	3	1	0	4	5
4.	MS17CS104	Big Data Management	HC	3	0	1	4	5
5.	MS17CS105	Advanced Networks	HC	3	1	0	4	5
6	MS17CS106	Probability & Statistics	HC	3	0	1	4	5
7.	MS17CS117	Distributed Algorithms Design	SC	3	1	0	4	5
	MS17CS127	Advanced Operating Systems						
	MS17CS137	Image Processing						
Total Credits				21	4	3	28	35

SECOND SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS201	Machine Learning algorithms	HC	3	1	0	4	5
2.	MS17CS202	Data Analytics using Python	HC	3	0	1	4	5
3.	MS17CS203	Cloud Computing	HC	3	1	0	4	5
4.	MS17CS214	Introduction to Web Technologies	SC	3	0	1	4	5
	MS17CS224	System Modelling and Simulation						
	MS17CS234	Information Storage Management						
5.	MS17CS215	Big Data and NoSQL	SC	3	0	1	4	5
	MS17CS225	Social Network Analytics						
	MS17CS235	Internet of Things						
6.	MS17CS216	Pattern Recognition	SC	3	1	0	4	5
	MS17CS226	Bio-Informatics						
	MS17CS236	Natural Language Processing						
7.	MS17CS217	Big Data Security	SC	3	1	0	4	5
	MS17CS227	Deep Learning						
	MS17CS237	Data ware housing and Business Intelligence						
Total Credits				21	4	3	28	35

THIRD SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS301	Open Elective	OE	3	1	0	4	5
2.	MS17CS312	Mobile n/w and computing	SC	3	1	0	4	5
	MS17CS322	Object Oriented Software Engineering						
	MS17CS332	IT Security						
3.	MS17CS313	Multivariate Methods for Data Analysis	SC	3	1	0	4	5
	MS17CS323	Stochastic Decision Science						
	MS17CS333	Advanced Web Technologies						
4.	MS17CS304	Minor Project / Internship	HC	1	1	6	8	15
Total Credits				**10**	**3**	**6**	**20**	**25**

FOURTH SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS401	Project Work and Dissertation	HC	2	4	14	20	38
Total Credits				**2**	**4**	**14**	**20**	**38**

Credit Summary

Semester	Credits
First	28
Second	28
Third	20
Fourth	20
Total	**96**

Semester	Hard Core (HC)	Fundamental Core (FC)	Soft Core (SC)	Open Elective (OE)	Total Credits
I	24	-	4	-	28
II	14	-	14	-	28
III	8	-	8	4	20
IV	20	-	-	-	20
Total Credits for Programme					**96**

MS in Computer Science

(With Specialization in Data Science and Analytics)

DETAILED SYLLABUS

FIRST SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS101	Multivariable Calculus	HC	3	1	0	4	5
2.	MS17CS102	Object Oriented Programming with JAVA	HC	3	0	1	4	5
3.	MS17CS103	Data Mining and Knowledge Discovery	HC	3	1	0	4	5
4.	MS17CS104	Big Data Management	HC	3	0	1	4	5
5.	MS17CS105	Advanced Networks	HC	3	1	0	4	5
6.	MS17CS106	Probability & Statistics	HC	3	0	1	4	5
7.	MS17CS117	Distributed Algorithms Design	SC	3	1	0	4	5
	MS17CS127	Advanced Operating Systems						
	MS17CS137	Image Processing						
Total Credits				**21**	**4**	**3**	**28**	**35**

DETAILED SYLLABUS

FIRST SEMESTER

Course Code	Multivariable Calculus	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS101		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- This course covers differential, integral and vector calculus for functions of more than one variable.
- These mathematical tools and methods are used extensively in the physical sciences, engineering, economics and computer graphics

Course Outcomes:

On successful completion of this course; the student will be able to:

- An ability to construct free-body diagrams.
- An understanding of the analysis of distributed contents.
- Calculate and interpret derivatives in up to three dimensions.
- Integrate functions of several variables over curves and surfaces.

Course Contents:

Unit – I-Matrices and Vectors **15 Hours**

Matrices, Matrices Operations, Related Matrices, Determinants, Properties of Determinants, Solution of Linear System of Equations, Vectors, Scalar or Dot Product, Vector or Cross product, Scalar Product of Three Vectors, Vector Product of Three Vectors, Differentiation of Vectors, Velocity and Acceleration.

Unit – II - Partial Differentiation and its Applications **15 Hours**

Functions of Two or More Variable, Partial Derivatives, Homogeneous Functions, Total Derivative, Geometrical Interpretation, Taylor's Theorem for functions of Two Variables, Maxima and Minima of Functions of Two Variables, Lagrange's Method of Undetermined Multipliers. Scalar and Vector Point Functions, Del Applied to Scalar Point Functions – Gradient, Del applied Twice to Point Functions, Del Applied to Products of Point Functions.

Unit – III - Double Integrals and its Applications **15 Hours**

Double Integrals, Change of Order of Integration, Double Integrals in Polar Coordinates; Area enclosed by Plane Curves, Integration of Vectors, Line Integral, Surface, Green's Theorem in the Plane, Stoke's Theorem.

Unit – IV - Triple Integrals and its Applications **15 Hours**

Triple Integrals, Volumes of Solids, Change of Variables, Area of a Curved Surface, Calculation of Mass, Centre of Gravity, Centre of Pressure, Volume Integral, Green's Theorem, Irrotational Fields, Solenoidal Fields, Orthogonal Curvilinear Coordinates, Cylindrical Coordinates, Spherical Polar Coordinates.

Recommended Learning Resources:

1) B S Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015, ISBN No: 978-81-7409-195-5
2) Calculus, Early Transcedentals Plus New May Math Lab by William Briggs, Lyle Cochran, and Gillet Pearson, Addison-Wesley, 2014.
3) Edwards, Henry C., and David E. Penney, Multivariable Calculus. 6th ed. Lebanon, IN: Prentice Hall, 2002. ISBN: 9780130339676.

Course Code	Object Oriented Programming with Java	Duration (Weeks)	Course Type	L	T	P	C	Hrs/Wk
MS17CS102		16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Understand fundamentals of object-oriented programming in Java, including defining Classes, invoking methods, using class libraries, exception handling etc.
- Solve problems using object-oriented paradigm
- Develop applications using threads and applet programming.
- Understand Java Database Connectivity.

Course Outcomes

On successful completion of this course, the student will be able to:

- Implement Java classes from specifications.
- Effectively create and use objects from predefined class libraries.
- Use interfaces, inheritance, and polymorphism as programming techniques.
- Use exceptions and multithreading.

Unit-I- Introduction to JAVA Programming **15 Hours**

An overview of Java, Internal Details of JVM Difference between JDK, JRE and JVM,Data types, variables, type conversion, casting, arrays, operators, arithmetic, bitwise, relational, Boolean, precedence, Control Statements.

Unit-II- Introduction to classes in java and members of the class **15 Hours**

Classes, abstract classes – the Object class, methods, constructors, Java static Method, this, Super and final keyword, dynamic binding overloading, inheritance, Packages, interfaces, String handling.

Unit-III- AWT and Applets **15 Hours**

Exception handling - Input/output Java streams - Threads - Abstract Windowing Toolkit - Overview, working with Windows, Graphics, Text, Images - AWT Controls - Applets - Scripts - Exploring Java

Unit-IV- Swings and JDBC **15 Hours**

Laying out components - Introducing Java Foundation Classes - Swing Packages – Swing – Introduction to JDBC- Type of Drivers- connecting and performing different operation on database.

Recommended Learning Resources:

1. Patrick Naughton and Herbert Schildt, ‘‘Java: The Complete Reference”, Tata McGraw-Hill, New Delhi, 1997.
2. Aaron Walsh and John Fronckowick, “Java Bible, Programming Version 2”, IDG Books Worldwide, Inc. 2000.
3. Balagurusamy E, “Programming with JAVA”, TMG, 2007
4. Deitel H.M, Deital P.J,”Java How to program”, Sixth Edition, Prentice Hall India, 2005.
5. ISBN: 0131483986

JAVA PROGRAMMING LAB

Part A

1. Demonstrate various I/O streams in java.
2. Demonstrate the Reader/Writer classes in java.
3. Demonstrate the multithreading concept by implementing Runnable interface.
4. Demonstrate the multithreading concept by extending Thread class.
5. Write an applet program and using paint function make some graphics.
6. Write a program to demonstrate the usage of different Layouts in java.
7. Write a java program to demonstrate various GUI components in java (AWT / SWING) with appropriate Event Handling.
8. Creating simple JDBC application

Part – B

Design a simple windows application using swings and MYSQL by following the constraints listed below

- Should be a team project with max of two
- All the layouts should be used in the entire project
- All the validations are must
- Packages, interfaces, inheritance and Exception handling concepts must be used

Course Code	Data Mining and Knowledge Discovery	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS103		16	HC	3	1	0	4	5

Course Objectives

The objectives of this course are to:
- Learn data analysis techniques through Data Mining.
- Understand Data mining techniques and algorithms.
- Comprehend the data mining environments and application.

Course Outcomes

On successful completion of this course, the student will be able to:
- Compare various conceptions of data mining as evidenced in both research and application.
- Characterize the various kinds of patterns that can be discovered by association rule mining.
- Evaluate mathematical methods underlying the effective application of data mining.
- Understand the process of Knowledge discovery

Course Contents

UNIT-I- Introduction to Data Mining **15 Hours**

Basics of Data Mining & Knowledge Discover , The Six Phases of Data Mining, Data mining Tasks, Data mining Case studies ,Statistical Perspective on data mining – Similarity Measures, Data Cleaning, Handling Missing Data, Data Transformations

UNIT-II - Classification **15 Hours**

Supervised and Unsupervised Learning, Methodology for Supervised Learning, Introduction – Statistical – based algorithms - Distance – based algorithms – Decision tree - based algorithms - Neural network – based algorithms

UNIT-III-Clustering **15Hours**

Introduction – Similarity and Distance Measures – Outliers, Partitional Methods, Hierarchical Methods, Density Based Methods. Features of Cluster Analysis.

UNIT-IV-Association Rule Mining **15 Hours**

Association rules: Introduction - Large item sets - Basic algorithms: Apriori algorithm – Generation of Association rules, Sampling Algorithm – Partitioning algorithms, Measuring the quality of rules.
Data Mining Applications: Data Mining for Financial Data Analysis - Data Mining for the Retail Industry - Data Mining for the Telecommunication Industry - Data Mining for Intrusion Detection.

Recommended Learning Resources:

1. Daniel.T.Larose Knowledge discovery, An Introduction to Data Mining, Wiley Publishers, 2014
2. Margaret H. Dunham, “Data mining introductory and advanced topics”, Pearson education, 2003. (Units 2,3 and 4)
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Addison Wesley, 2005.
4. G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI, New Delhi, 2009.

Course Code	Big Data management	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS104		16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- This course brings together several key big data technologies used for storage analysis and manipulation of data..
- Prepare a sample project in Hadoop API.

Course Outcomes

On successful completion of this course, the student will be able to:

- Categorize and summarize Big Data and its importance.
- Differentiate various Big data technologies like Hadoop, MapReduce, Pig, Hive, Hbase and No- SQL.
- Recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive,and No-SQL
- Apply tools and techniques to analyze Big Data.

Course Contents

UNIT-I-Introduction to Big Data **15 Hours**

Introduction – distributed file system – Big Data and its importance, Four Vs, Types of Data structured, unstructured and Semi-structured data. Drivers for Big data, Big data applications. Industry examples of Big Data.(T1 and distributed computing book).

UNIT-II- Big Data Analytics **15 Hours**

Big data analytics, Business Intelligence and Big Data, Types of Big data Analytics, Use cases– Crowd Sourcing Analytics – Text analytics. Cloud and Big Data, Information Management.

UNIT-III- Processing Big Data **15 Hours**

Integrating disparate data stores - Mapping data to the programming framework- Connecting and extracting data from storage - Transforming data for Processing.
Map Reduce, Map Reduce examples, The Building Blocks of Hadoop Map Reduce, Creating the components of Hadoop Map Reduce jobs, Understanding inputs and outputs of MapReduce - Data Serialization. Hadoop’s Parallel World, Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop,

UNIT-IV-HDFS and HIVE **15 Hours**

Hadoop Architecture, Hadoop Storage: HDFS.Investigating the Hadoop Distributed File System
Selecting appropriate execution modes: local, pseudo-distributed, fully distributed
Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating.

Recommended Learning Resources:

1. Ambiga Dhiraj , Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Business”, 1st Edition, , Wiely CIO Series, 2013
2. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, 1st Edition, IBM Corporation, 2012.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
4. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
5. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012.
6. Tom White, “HADOOP: The definitive Guide” , O Reilly 2012.

Hadoop Programming Lab

1. Consider a company of electronic goods. The company is maintaining the excel file of the goods sold in every month. Find out Number of Products Sold in Each Country**.**

2. Using movie lens data

i. List all the movies and the number of ratings
ii. List all the users and the number of ratings they have done for a movie
iii. List all the Movie IDs which have been rated (Movie Id with at least one user rating it)
iv. List all the Users who have rated the movies (Users who have rated at least one movie)
v. List of all the User with the max, min, average ratings they have given against any movie
vi. List all the Movies with the max, min, average ratings given by any user

3. MapReduce

i. Create a JOB and submit to cluster ii.
Track the job information
ii. Terminate the job
iii. Counters in MR Jobs with example
iv. Map only Jobs and generic map examples
Distributed cache example
v. Combiners, Secondary sorting and Job chain examples

4. WordCount

Let’s understand the problem through a sample text file content:

“Hello everyone this is a sample dataset. You need to print the word count of particular words in this dataset.”

Your MapReduce program should process this text file and should provide output as follows:

Output

Word Word Count

a 1 (As the word ‘a’ occurred only once)

this 2 (As the word ‘this’ occurred twice)

5. WordSizeWordCount Program

Apply your MapReduce programming knowledge and write a MapReduce program to process two text files. You need to calculate the size of each word and count the number of words of that size in the text file.

The dataset for this problem is the text file ‘alphabets’ available in your LMS.

Problem statement

Let’s understand the problem through a sample text file content:

“Hello everyone this is a sample dataset. Calculate the word size and count the number of words of that size in this text file.”

Your MapReduce program should process this text file and should provide output as

follows: Sample Output

Word Size	Word Count
1	1 (As the word of size 1 is: a)
2	4 (As the words of size 2 are: is, of, of, in)
3	3 (As the words of size 3 are: the, and, the)
4	6 (As the words of size 4 are: this, word, size, that, size)

Course Code	Advanced Networks	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS105		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Make students build an understanding of the fundamental concepts of computer networking;
- Make students to become Familiar with the basic taxonomy and terminology of the computer networking area;
- Introduce the students to advanced networking concepts, preparing the student for entry Advanced courses in computer networking;
- Allow the students to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

- Independently understand basic computer network technology;

- Understand and explain Data Communications System and its components;
- Identify the different types of network topologies and protocols;
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer;
- Identify the different types of network devices and their functions within a network;
- Become familiar with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Contents:

Unit-I-Computer Networks and the Internet **15 Hours**

What Is the Internet? Network Edge; Network Core; Delay, Loss, and Throughput in Packet-Switched Networks; Protocol Layers and Their Service Models.

Application Layer: Principles of Network Applications; Web and HTTP; File Transfer: FTP; Electronic Mail in the Internet; DNS—The Internet's Directory Service; Peer-to-Peer Applications; Socket Programming: Creating Network Application.

Unit-II-Transport Layer **15Hours**

Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Principles of Reliable Data Transfer; Connection-Oriented Transport: TCP; Principles of Congestion Control; TCP Congestion Control

The Network Layer: Introduction; Virtual Circuit and Datagram Networks; what's Inside a Router? The Internet Protocol (IP): Forwarding and Addressing in the Internet; Routing Algorithms; Routing in the Internet; Broadcast and Multicast Routing

Unit-III-The Link Layer: Links, Access Networks, and LANs **15 Hours**

Introduction to the Link Layer; Error-Detection and -Correction Techniques; Multiple Access Links and Protocols; Switched Local Area Networks; Link Virtualization: A Network as a Link Layer; Data Center Networking; Retrospective: A Day in the Life of a Web Page Request

Wireless and Mobile Networks **15 Hours**

Introduction; Wireless Links and Network Characteristics; WiFi:
802.11 Wireless LANs; Cellular Internet Access; Mobility Management: Principles; Mobile IP; Managing Mobility in Cellular Networks; Wireless and Mobility: Impact on Higher-Layer Protocols

Unit-IV-Security in Computer Networks **15 Hours**

What Is Network Security? Principles of Cryptography; Message Integrity and Digital Signatures; End-Point Authentication; Securing E-Mail; Securing TCP Connections: SSL; Network-Layer Security: IPsec and Virtual Private Networks; Operational Security: Firewalls and Intrusion Detection Systems

Network Management: What Is Network Management? The Infrastructure for Network Management; The Internet-Standard Management Framework.

Recommended Learning Resources:

1. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, . Addison- Wesley, 6/E edition, 2013.
2. Nader F. Mir, Computer and Communication Networks, Pearson Education, 2007.
3. Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition, Tata McGraw Hill, 2007.

4. Andrew S. Tanenbaum , Computer Networks , , Prentice Hall, 5th edition, 2011.
5. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, . Morgan Kaufmann, 5th edition, 2011.

Course Code	Probability & Statistics	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS106		**16**	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Know the different Sampling Techniques used in Big data and related areas
- Introduce Random variables, Random vectors and distributions
- Learn the statistical procedures most often used by practicing engineers.
- Understand Forecasting methods and apply for business applications.

Course Outcomes

On successful completion of this course, the student will be able to:

- Deal with the different Sampling Techniques used in Big data and related areas
- Design Random variables, Random vectors and distributions
- Learn the statistical procedures most often used by practicing engineers.
- Understand Forecasting methods and apply for business applications

Course Contents

UNIT-I-Statistics **15 Hours**

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation -

Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode,

Median,
Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

UNIT-II- Probability and Hypothesis Testing **15 Hours**

Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of t-distribution, F-distribution, $\chi 2$ distribution.

UNIT-III-Predictive Analytics **15 Hours**

Predictive modelling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and goodness of fit.

UNIT– IV-Time Series Forecasting And Design Of Experiments 15 Hours

Forecasting Models for Time series: MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design.

Recommended Learning Resources:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., "Understanding Big Data", McGraw HIll, 2012.

2. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014.

3. Eric Siegel, Thomas H. Davenport, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", Wiley, 2013.

4. James R Evans, "Business Analytics – Methods, Models and Decisions", Pearson 2013.

5. R. N. Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2015.

6. S M Ross, "Introduction to Probability and Statistics for Engineers and Scientists", Academic Foundation, 2011.

7. David Hand, Heiki Mannila, Padhria Smyth, "Principles of Data Mining", PHI 2013.

8. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, "Forecasting methods and applications", Wiley 2013(Reprint).

9.David Hand, Heikki Mannila, Padhraic Smyth, "Principles of Data mining", PHI 2013.

10. http://cran.r-project.org/doc/manuals/R-intro.html

11. W.N. Venables, D.M Smith, "An introduction to R",

12. R in Nutshell , O Reilly,

Probability in R

Tossing a coin

The probability of getting a Heads or a Tails on a coin toss is both 0.5. We can use R to simulate an experiment of flipping a coin a number of times and compare our results with the theoretical probability. First let x the convention:

0 = Tails and 1 = Heads

1. Use R to simulate an experiment of tossing a coin 100 times. Print the relative histogram as above with your your name on it.
2. Find the relative frequency of a Tail and Head in your experiment and fill in the table on the next page.
3. Repeat 2 for tossing a coin 500 times (do not print histogram).
Rolling dice
The probability of getting a number between 1 to 6 on a roll of a die is 1=6 = 0:1666667.
As above we can use R to simulate an experiment of rolling a die a number of times and compare our results with the theoretical probability. We can use the following command to tell R to roll a die 20 times:
4. Use R to simulate an experiment of rolling a die 200 times. Print the relative histogram and write your name on it.
5. Find the relative frequency of the numbers 1 to 6 in your experiment and fill in the table on

Course Code	Course Title	Duration	Course Type	L	T	P	C	Hrs./ Wk.
MS17CS117	**Distributed Algorithms Design**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Provide an overview of distributed computing environment
- Describe the core ideas behind modern coordination and communication paradigms and distributed data structures;
- Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs;
- Realize the basic principles and also the best practice engineering techniques of concurrent and distributed computing;
- Present techniques to formally study the safety and progress properties of concurrent and distributed algorithms

Course Outcomes

On successful completion of this course; the student will be able to:

- Make students to understand the concepts behind distributed algorithms
- List and classify various distributed algorithms
- Assess the applicability of distributed algorithms to a particular circumstance.
- Familiar with various distributed set operations

Course Contents

UNIT I - Introduction to Algorithms **15 Hours**

Introduction to Preliminaries - Design and Analysis Fundamentals - Mathematical Tools for Algorithm Analysis - Trees and Applications to Algorithms - More on Sorting Algorithms - Probability and Average Complexity of Algorithms.

UNIT II - Design Strategies **15 Hours**

Major Design Strategies - The Greedy Method – Divide and Conquer - Dynamic Programming – Backtracking and Branch and Bound.

UNIT III - Graph and Network Algorithms **15 Hours**

Graph and Network Algorithms - Graphs and Digraphs - Minimum Spanning Tree and Shortest-Path Algorithms - Graph Connectivity and Fault-Tolerance of Networks - Matching and Network Flow Algorithms.

UNIT IV - Parallel and Distributed Algorithms **15 Hours**

Parallel and Distributed Algorithms - Introduction to Parallel Algorithms and Architectures – Parallel Design Strategies - Internet Algorithms -Distributed Computation Algorithms - Distributed Network Algorithms.

Recommended Learning Resources :

1. Design and Analysis of Distributed Algorithms, First Edition, Nicola Santoro, Wiley Publications, 2006.
2. Nancy Ann Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, 1996
3. . Kenneth A. Berman, Jerome L. Paul , "Algorithms: Sequential, Parallel, and Distributed", Amazon Bestsellers, 2004.
4. Russ Miller, Laurence Boxer, "Algorithms Sequential and Parallel: A Unified Approach", Prentice Hall, 1 edition, 1999.
5. Dimitri P. Bertsekas and John N. Tsitsiklis, "Parallel and Distributed Computation: Numerical Methods", Prentice Hall, 1989.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS127	**Advanced Operating Systems**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives:

The objectives of this course are to:

- Introduce the overview of operating system, process description and its control.
- Study T h r e a d s , SMP, and microkernel and virtual memory concepts.
- Provide systematic and comprehensive treatment of operating system;
- Provide a strong foundation in distributed resource management components. viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols;

Course Outcomes:

On successful completion of this course; the student will be able to:

- Demonstrate a fundamental knowledge of Windows, Linux, Unix, TinyOS, description and its control

- Impart the knowledge about Threads, SMP, microkernel and virtual memory concepts.
- Demonstrate a fundamental knowledge of the various resource management techniques for distributed systems;
- Gain expertise in the security and kernel organization

Course Contents:

Unit-I- Multiple Processor Systems 18 Hours

MULTIPROCESSORS: Definition, Advantages, Classification, Multiprocessor Interconnections, Types of Multiprocessor Operating Systems, Multiprocessor OS Functions and Requirements, OS Design and Implementing Issues, Multicomputer, Virtualization, Multiprocessor Scheduling.

Unit-II- Distributed Operating System 14 Hours

Definition, Need, Models of Distributed Systems, Distributed Message Passing, Remote Procedure calls, Algorithms for Distributed Processing.

Unit-III- Multimedia Operating Systems 14 Hours

Introduction to Multimedia; Multimedia files: Video Encoding, Audio Encoding; Video compression: The JPEG Standard, The MPEG Standard; Audio compression; Multi-media process Scheduling.

Unit-IV- Embedded System & Network Operating SysteM 14 Hours

Embedded System: Definition, Need, Characteristics, Types of Embedded OS- Tiny OS; Network OS: Definition, Features of NOS, Types Of NOS, Windows Server VS Linux Server.

Recommended Learning Resources:

1) “Modern Operating System” By Andrew S Tanenbaum, 3rd ed (ch 7, 8)
2) “Operating Systems” concepts and design By Milan Milinkovic, 2nd ed
3) “Operating Systems” Internals and design Principles By William Stallings ,6th ed
4) Springer, Springer transaction for advance in Distributed computing and middleware.
5) IEEE,IEEE transaction for Real time operating system.
6) ACM, ACM transaction for embedded operating system

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Course Code	Image Processing	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS137		16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Introduce the special and frequency domain processing
- Make students to become Familiar with Segmentation and edge detection
- Explain the basics of digital images, noise models, spatial domain filters
- Describe frequency domain filters, basic image analysis --- segmentation, edge detection, and corner detection
- Teach morphological operations and texture analysis
- Explain processing of color images and image compression techniques

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand special and frequency domain processing
- Understand image modalities, sensing, acquisition, sampling, and quantization, image noise models
- Analyze spatial filter operations, frequency domain transformations
- Implement and Apply segmentation algorithms, edge detection techniques, corner and interest point detection algorithms and morphological operations

Course Contents

Unit-I - Spatial Domain Processing **15 Hours**

Introduction to image processing, imaging modalities, image file formats, image sensing and acquisition, image sampling and quantization. Noise models, spatial filtering operations, histograms, smoothing filters. Sharpening filters. Fuzzy techniques for spatial filtering, spatial filters for noise removal

Unit-II - Frequency Domain Processing **15 Hours**

Frequency domain, Review of Fourier Transform (FT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT), filtering in frequency domain, image smoothing, image sharpening, selective filtering, frequency domain noise filters, wavelets, Haar Transform, multi-resolution expansions, wavelet transforms, wavelets based image processing.

Unit-III - Segmentation and Edge Detection **15 Hours**

Thresholding techniques, region growing methods, region splitting and merging, adaptive thresholding, threshold selection, global valley, histogram concavity, edge detection, template matching, gradient operators, circular operators, differential edge operators, hysteresis thresholding , Canny operator, Laplacian operator, active contours, object segmentation.

Unit-IV - Interest Points and Texture **15 Hours**

Corner and interest point detection, template matching, median filter based detection, Harris interest point operator, corner orientation, local invariant feature detectors and descriptors, texture & texture analysis.

Image Compression: Image Compression, redundancy in images, coding redundancy, irrelevant information in images, image compression models, basic compression methods, digital image watermarking.

Recommended Learning Resources:

1. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
2. W. Burger and M. Burge, “Digital Image Processing: An Algorithmic Introduction using Java”, Springer, 2008.
3. John C. Russ, “The Image Processing Handbook”, Sixth Edition, CRC Press, 2011.
4. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”, Third Edition, Pearson, 2008.
5. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
6. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packet Publishing, 2012.
7. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.
8. ACM Transactions on Modeling and Computer Simulation (TOMACS)
9. IEEE transaction on Image Processing
10. ACM Transactions on Graphics

Image Processing Lab

The Lab component will be decided by the faculty. The lab can be done either using MATLAB/SCI LAB.

SECOND SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern			Credits	Working Hours
				L	T	P		
1.	MS17CS201	Machine Learning algorithms	HC	3	1	0	4	5
2.	MS17CS202	Data Analytics using Python	HC	3	0	1	4	5
3.	MS17CS203	Cloud Computing	HC	3	1	0	4	5
4.	MS17CS214	Introduction to Web Technologies	SC	3	0	1	4	5
	MS17CS224	System Modelling and Simulation						
	MS17CS234	Information Storage Management						
5.	MS17CS215	Big Data and NoSQL	SC	3	0	1	4	5
	MS17CS225	Social Network Analytics						
	MS17CS235	Internet of Things						
6.	MS17CS216	Pattern Recognition	SC	3	1	0	4	5
	MS17CS226	Bio-Informatics						
	MS17CS236	Natural Language Processing						
7.	MS17CS217	Big Data Security	SC	3	1	0	4	5
	MS17CS227	Deep Learning						
	MS17CS237	Data ware housing and Business Intelligence						
Total Credits				**21**	**4**	**3**	**28**	**35**

Course Code	Machine Learning algorithms	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS201		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to

- Introduce the fundamental problems of machine learning;
- Impart basic knowledge of the key algorithms and theory that form the foundation of machine learning;
- Provide understanding of techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area;
- Provide understanding of the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms;

Course Outcomes:

On successful completion of this course, the student will be able to:

- Understand the basic theory underlying machine learning;
- Formulate machine learning problems corresponding to different applications;
- Understand the principles, advantages, limitations and possible applications of machine learning;
- Apply machine learning algorithms to solve classification, pattern recognition, and optimization and decision problems of moderate complexity.

Course Contents:

Unit-I - Introduction **15 Hours**

Machine Learning; Machine Learning Foundations, Overview – applications - Types of machine learning, Basic concepts in machine learning Examples of Machine Learning, Applications - Linear Models for Regression; Linear Basis Function Models; The Bias-Variance Decomposition Bayesian Linear Regression, Bayesian Model Comparison

Unit-II - Supervised Learning **15 Hours**

Linear Models for Classification; Discriminant Functions; Probabilistic Generative Models; Probabilistic Discriminative Models; Bayesian Logistic Regression; Decision Trees; Classification Trees- Regression Trees; Pruning; Neural Networks; Feed-forward Network Functions, Error Back propagation; Regularization, Mixture Density and Bayesian Neural Networks, Kernel Methods Dual Representations; Radial Basis Function Networks; Ensemble methods- Bagging- Boosting

Unit-III - Unsupervised Learning **15 Hours**

Clustering- K-means - EM - Mixtures of Gaussians, The EM Algorithm in General -Model selection for latent variable models -; high-dimensional spaces -- The Curse of Dimensionality -Dimensionality Reduction, Factor analysis; Principal Component Analysis - Probabilistic PCA; Independent components analysis

Unit-IV- Probabilistic Graphical Models **15 Hours**

Directed Graphical Models, Bayesian Networks, Exploiting Independence Properties, From Distributions to Graphs, Examples -Markov Random Fields - Inference in Graphical Models Learning –Naive Bayes classifiers-Markov Models; Hidden Markov Models, Inference, Learning Generalization, Undirected graphical models- Markov random fields; Conditional independence properties - Parameterization of MRFs - Examples - Learning, Conditional
random fields (CRFs) Structural SVMs

Recommended Learning Resources:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. EthemAlpaydin, Introduction to Machine Learning, Prentice Hall of India, 2005.
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
5. Hastie, Tibshirani, Friedman, The Elements of Statistical Learning (2nd ed.), Springer, 2008.
6. Stephen Marsland, Machine Learning –An Algorithmic Perspective, CRC Press, 2009.
7. IEEE Transactions on Pattern Analysis and Machine Intelligence
8. Journal of Machine Learning Research , 4 (2003): 971-1000.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS202	Data Analytics using Python	16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Understanding the basic concepts of Python
- Preparing and pre-processing data
- Understanding the data aggregation and grouping concepts
- Leveraging web scraping
- Visualizing the results of analytics effectively

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the basics concepts of python
- Prepare and pre-process the data
- Understand the data aggregation and grouping concepts
- Leverage web scraping Visualize the results of analytics effectively

Course Contents

Unit-I-Introduction of Python **15 Hours** Programming Basics and Strings, Numbers and Operators, Variables — Names for Values, Functions, Classes and Objects, Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing

Unit-II-Getting Started with pandas **15 Hours** Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data , Hierarchical Indexing

Unit-III-Data Loading, Storage, and File Formats **15 Hours** Reading and Writing Data in Text Format, Binary Data Formats, Interacting with HTML and Web APIs,Interacting with Databases, Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.

Unit-IV-Data Wrangling: Clean, Transform, Merge, Reshape **15 Hours**
GoupBy Mechanics – Data Aggregation – Groupwise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting, Data Acquisition by Scraping web applications –Submitting a form -
Fetching web pages – Downloading web pages through form submission – CSS Selectors.

Recommended Learning Resources:

McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

Payne, J. (2010). Beginning Python: Using Python 2.6 and Python 3.1. Wrox Press Ltd..
Michael Urban Joel Murach, murach's Python Programming,Shroof publishers,2017.

Data Analytic using Python Lab

1. Write a Python program to create and display a one-dimensional array-like object containing an array of data using Pandas module.
2. Write a Python program to convert a Panda module Series to Python list and it's type.
3. Write a Python program to add, subtract, multiple and divide two Pandas Series.
4. Write a Python program to get the largest integer smaller or equal to the division of the inputs.
5. Write a Python program to create and display a DataFrame from a specified dictionary data which has the index labels.

. Write a Python program to display a summary of the basic information about a specified DataFrame and its data.

6. Write a Python program to get the first 3 rows of a given DataFrame.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS203	**Cloud Computing**	**16**	**HC**	**3**	**1**	**0**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Introduce the broad perceptive of cloud architecture and model
- Understand the concept of Virtualization and design of cloud Services
- Be familiar with the lead players in cloud.
- Understand the features of cloud simulator
- Apply different cloud programming model as per need.
- Learn to design the trusted cloud Computing system

Course Outcomes

On successful completion of this course, the student will be able to:

- Compare the strengths and limitations of cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player, Programming Models and approach.
- Address the core issues of cloud computing such as security, privacy and interoperability

Course Contents

Unit-I-Fundamentals of Cloud Computing 15 Hours

Cloud computing at a glance, The vision of cloud computing, Defining a cloud, A closer look, Historical developments, Building cloud computing environments Application development, Computing platforms and technologies Principles of Parallel and Distributed Computing, Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing- ,Scaling and types of scaling, Service-oriented computing.

Unit-II-Fundamental concept and Models 15 Hours

Basics of Virtualization, Characteristics of virtualized environments, Taxonomy of virtualization techniques, - Types of Virtualization, Virtualization and cloud computing, Technology examples, Xen: paravirtualization, VMware: full virtualization –Just introduction.

Unit-III-Cloud Infrastructure Mechanisms and Architecture 15 Hours

The cloud reference model, Cloud Delivery Models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), Comparing Cloud Delivery Models, Cloud

Deployment Models: Public Clouds, CommUnity Clouds, Private Clouds, Hybrid Clouds, Fundamentals of Cloud Architecture, Introduction to Cloud Software Environments , Architecture of Eucalyptus, Open Stack, Aneka.

Unit-IV-Cloud Applications **15 Hours**

Scientific applications, Healthcare: ECG analysis in the cloud, Biology: protein structure prdiction, Geoscience: satellite image processing, Business and consumer applications, CRM and ERP, Social networking, Deploying applications in the cloud, open cloud platforms AWS,GAE.

Recommended Learning Resources:

1. Rajkumar Buyya, Christian Vechiolla, Thamarai Selvi, "**Mastering Cloud Computing**, Elsevier publications, 2013, USA
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "**Cloud Computing: Principles and Paradigms",** Wiley, India .
3. Kai Hwang, Geoffrey C Fox, Jack G Dungaree, "Distributed and Cloud Computing, From ParallelProcessing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4. Thomas Erl, Zaigham,Mahmood, Ricardo Puttini, " **Cloud Computing:Concepts, Technology & Architecture"**, Prentice Hall/Pearson.
5. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation Management,and Security", CRC Press, 2010.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH,2009.

Course Code	**Introduction to Web Technologies**	**Duration (Weeks)**	**Course Type**	**L**	**T**	**P**	**C**	**Hrs./Wk.**
MS17CS214		**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Learn core technical skills necessary for a complete understanding of front-end web development, including HTML 5 and CSS, JavaScript, DOM.
- Understand rich internet applications that use most recent client-side programming technologies.
- Understand client-side validations using Java Script.

Course Outcomes

On successful completion of this course, the student will be able to:

- Gain knowledge on HTML(5)+CSS programming skills.
- Develop basic HTML, CSS and Java script programming.
- Design and implement web pages.
- Create a site that has a consistent outlook and its functionalities work on different platforms.

Course Contents

Unit-I - Introduction **15 Hours**

The World Wide Web, WWW Architecture, Web Search Engines, Web crawling, Web indexing, Web Searching, Search engines optimization and limitations, Introduction to the semantic web.
Basic HTML: Structure of HTML, Comments, Blocks of text, Paragraphs, Line breaks, Horizontal rules, Quoted paragraphs,. Dividing text into blocks, Pre-formatted text, Logical tags, Fonts, Headers, Font, Font styles, Character entities, Links, Destination, Lists, Images, Tables, Forms, Form elements

Unit-II-HTML 5 **15Hours**
Detecting HTML 5 features – Canvas, video, local storage, web workers, offline applications, geolocation, placeholders, and input types. What does it all mean –doctype, root, headers, articles, dates and times, navigation and footers. Simple shapes, canvas, Paths, texts, gradients and images. A Form of madness – place holders, autofocus fields, email, and numbers as spin boxes and sliders.

Unit-III-The Basics of JavaScript **15 Hours**

Object orientation and JavaScript, Syntax, Primitives, operations and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors, and Pattern matching. The DOM, Elements Access, Event Handling- Body tag, Text Box and Password elements. Element's Positioning, Visibility, Stacking.

Unit-IV- Introduction to Angular-JS and Introduction to XML **15 Hours**

ANGULAR JS: Understanding jQuery ,Event Manipulation Methods, AngularJS Template & live data binding, Struts architecture & versions
Introduction to XML
Document structure, DTDs, Namespaces, XML schemas, Displaying XML documents with CSS, Displaying raw XML documents

Recommended Learning Resources:

1. Robert W. Sebesta, Programming the World Wide Web, Pearson Education 2008.

2. Achyut S. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.

3. Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.

4. Paul S Wang, SandaKatila An introduction to Web design and programming Cengage Course, 2003.

Exercises:

Unit 1: Develop a web application using XHTML tags and CSS.
Unit 2: Develop a user registration form using HTML5 Controls and CSS.
Unit 3: Expand the above registration form and add validations using JS.
Unit 4: To the above registration form, read the form data and display it on the next page.

PART-A

1. Create an HTML5 page to demonstrate the usage of
    a. Text Formatting tags
    b. Links
    c. Images
    d. Tables
2. Develop and demonstrate the usage of inline and external style Sheet using CSS.
3. Write a Program using JavaScript to display a table of the numbers from 5 to 15 and their squares and cubes using alert.
4. Develop and demonstrate using Java script, a XHTML document that display random numbers (integers).
5. Program to demonstrate various event handlers when an image is moved from the top stacking position, it returns to its original position using JavaScript.
6. Develop using Java script, an XHTML document that use of on load and on focus events.
7. Program on xml to read Employee details and display the details using CSS.
8. Develop a web form to display the student details using XML and XSLT style sheets.

PART-B

1. Build a client-side web application in the following areas:
    a. Educational Institutions.
    b. Online shopping.
    c. Hospital Management System.
    d. Real Estate.
    e. Reservation System.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS224	System Modelling and Simulation	16	SC	3	1	0	4	5

Course Objective

The objectives of this course are to:

- Learn the benefits of simulation and modeling in a range of important application areas.
- Explain the event – scheduling, time-advance algorithm in computer networks.
- Describe the essentials of probability and random process
- Introduce discrete event stochastic models and **queuing models**

Course Outcomes

On completion of this course the student will be able to:

- Make students to understand the concepts of simulation for systems
- Describe the role of important elements of simulation and modeling paradigm.
- Apply the mathematical techniques to model and analyze structural and dynamical properties of Discrete-Event systems.
- Describe Output analysis for discrete-event simulation algorithms.

Course Contents

Unit-I- Introduction **15 Hours**

Why is Simulation Important? When simulation is the appropriate tool and when it is not appropriate, Areas of application, Systems and system environment; Components of a system, Discrete and continuous systems, Model of a system; Types of Models; Discrete-Event System Simulation. Simulation examples: Simulation of queuing systems; Simulation of inventory systems; other examples of simulation. What is model? Advantages and Disadvantages of Modeling and Simulation, Common Pitfalls of Modeling and Simulation and Rules of Thumb, Overview of M&S tools

Simulation Software: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event scheduling; List processing.

Unit-II-Statistical& Queuing Models **15 Hours**

Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions. Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.

Unit-III-Random-Number Generation, Random-Variate Generation 15 Hours

Properties of random Numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers. Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; selecting input models without data; Multivariate and Time-Series input models.

Unit-IV-Verification and Validation of Simulation Models, Optimization 15 Hours

Model building, verification and validation; Verification of simulation models; Calibration and validation of models. Optimization via Simulation

Modeling and Simulation using NS2: RF Propagation Wired MANE, Network Layer.

Recommended Learning Resources:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, ’’Discrete-Event System Simulation’’, Pearson Education, 4th edition, 2007.
2. Jack L. Burbank, William Kasch and Jon Ward, “An Introduction to Network Modeling and Simulation for the Practicing Engineer”, Wiley publication, 2011.
3. Lawrence M. Leemis and Stephen K. Park, ‘’Discrete – Event Simulation a First Course’’, Pearson Education/PHI, 4th edition, 2006.
4. Averill M. Law, ‘’Simulation Modeling and Analysis’’, Tata McGraw-Hill, 4th edition, 2007.
5. ACM Transactions on Modeling and Computer Simulation (TOMACS)
6. IEEE Transactions on Networking (TON)
7. ACM Transactions on Networking (TON)

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS234	**Information storage management**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives:

The objectives of this course are to:

- Identify the components of managing the data center and Understand logical and physical components of a storage infrastructure.
- Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN,CAS
- Understand the business continuity, backup and recovery methods.
- Learn variety of solutions for storing, managing, accessing, protecting, securing, sharing and optimizing information

Course Outcomes

On successful completion of this course, the student will be able to:

- Identify the components of managing the data center and Understand logical and physical components of a storage infrastructure.

- Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN,CAS
- Understand the business continuity, backup and recovery methods.
- Learn variety of solutions for storing, managing, accessing, protecting, securing, sharing and optimizing information

Course Contents

UNIT-I-Introduction to Storage and Management **15 Hours**

Introduction to Information Storage Management - Data Center Environment–Database Management System (DBMS) - Host - Connectivity –Storage-Disk Drive Components- Intelligent Storage System -Components of an Intelligent Storage System- Storage Provisioning- Types of Intelligent Storage Systems.

UNIT-II-Storage Networking **15 Hours**

Fibre Channel: Overview - SAN and Its Evolution -Components of FC SAN -FC Connectivity-FC Architecture- IPSAN-FCOE-FCIP-Network-Attached Storage- General-Purpose Servers versus NAS Devices - Benefits of NAS- File Systems and Network File Sharing-Components of NAS - NAS I/O Operation -NAS Implementations -NAS File-Sharing Protocols-Object-Based Storage Devices-Content-Addressed Storage -CAS Use Cases.

UNIT-III-Backup and Recovery **15 Hours**

Business Continuity -Information Availability -BC Terminology-BC Planning Life Cycle - Failure Analysis -Business Impact Analysis-Backup and Archive - Backup Purpose -Backup Considerations - Backup Granularity - Recovery Considerations -Backup Methods -Backup Architecture - Backup and Restore Operations.

UNIT-IV-Securing and Managing Storage Infrastructure **15 Hours**

Information Security Framework -Storage Security Domains-Security Implementations in Storage Networking - Monitoring the Storage Infrastructure -Storage Infrastructure Management Activities - Storage Infrastructure Management Challenges.

Recommended Learning Resources:

1. EMC Corporation, Information Storage and Management, WileyIndia, 2nd Edition, 2011.
2. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, Building Storage Networks, Tata McGraw Hill , Osborne,2nd Edition, 2001.
4. Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

Information Storage System Lab

1. Write a PL/SQL code to retrieve the employee name, join_date, and designation from employee database of an employee whose number is input by the user.
2. Write a PL/SQL code to show TABLE type of data(Array)
3. Write a PL/SQL code to calculate tax for an employee of an organization – XYZ and to display his/her name & tax, by creating a table under employee database as below.
    a. Employee_salary

Emp_no	Basic	HRA	DA	Total_deduction	Net_salary	Gross_salary

4. Write a PL/SQL code to display employee number, name and basic of 5 highest paid employees.
5. Write a PL/SQL code to calculate the total salary of first n records of emp table. The value of n is passed to cursor as parameter.
6. Write a PL/SQL code to update the salary of employees who earn less than the average salary.

LAB PART B

i. Create an object type called **current_weather_typ** to model current weather observations. This type should have attributes for city, state, current temperature, and current status (such as snowy, sunny, etc.)

ii. Create an object table called **current_weather** with the only column defined as the datatype you just created.

iii. Perform a **DESCRIBE** on both the type and the table you created to verify that all has been created properly

iv. Insert the following values into the table you created.

City	State	Temp	State
New York	NY	32	Sunny
Boston	MA	27	Cloudy
Chicago	IL	15	Blizard

v. Query the table to ensure the values have been entered correctly.

vi. Modify the type to add a new attribute for the wind speed. Query the table to see the results of your change and the values for your new attribute

vii. Create a procedure called **new_weather** that will insert a new row of data into the table, accepting the type attributes as input.

viii. Use the new procedure to add a new weather report into the table. Query the table to ensure the data was added correctly.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS215	**Big Data and NoSQL**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Learn the latest trends in databases.
- Acquire knowledge in parallel, distributed databases and its applications.
- Understand the usage of advanced data models.
- Learn emerging databases like Mongo DB, Cassandra, H Base etc.
- Understand the principles behind Map reduce.

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the latest trends in databases
- Distinguish between the types of NOSQL databases.
- Understand the data models in these databases.
- Design and write queries in NOSQL Databases

Course Contents

Unit-I-Introduction to NOSQL **15 Hours**

Introduction to NoSQL Definition of NOSQL-Challenges in traditional RDBMS- Need for NOSQL- Big Data and NoSQL, History of NOSQL and Different NOSQL products aggregate data models Need for schema less databases -Types of NOSQL Data bases- key-value Column store, document data models and Graph Data models.

NOSQL Storage Architecture Key-value stores internals -Column Family Databases-internals, Document Databases internals- Graph database internals.

Unit-II-Key-Value Stores and Column stores **15 Hours** Introduction to Key-value stores- Exploring Redis Redis data model Storing Data in and Accessing Data from Apache Redis –Querying in Redis using examples Redis use cases. Introduction to Column stores- Exploring HBASE – HBASE data model Storing Data CRUD operations in HBASE.

Unit-III-Document stores and its applications **15 Hours**

Introduction to Document stores, Exploring MongoDB, MongoDB data model, Storing Data in and Accessing Data from MongoDB, Querying in MongoDB using examples, Interact with MongoDB using any one Language Binding(Java/Python/PHP). MongoDB use cases. Mongo DB storage architecture

Unit-IV-Big Data Handling in NoSQL **15 Hours**

Big Data processing with MongoDB, Import and Export commands in MongoDB, MongoDB Indexing, Map Reduce concepts, Map Reduce in MongoDB. Horizontal Scaling through sharding.

Advanced NOSQL

Database Administration.

Recommended Learning Resources:

1. The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop Computing, Apress 2010 .

2. Lars GeorgeHBase: A definitive Guide, OReilly publications,2011.

3. Josiah L. Carlson, Redis in Action,Manning Publications, 2013.

Reference Books:

4. “Professional NOSQL” by Shashank Tiwari, 2011, WROX Press

5. Kristina Chodorow, MongoDB: The Definitive Guide, 2nd Edition, O’Reilly publications,2013

6. Joel Grus, Data Science from Scratch, Shrooff publishers, 2017

Reference Websites:

1. www.mongodb.org
2. www.redis.io
3. www.hbase.apache.org

NoSQL Laboratory

1. NoSQL Lab CRUD operations in Key-value stores Redis
2. CRUD operations using Column family stores HBASE.
3. CRUD- Operations using MongoDB
4. Connecting MongoDB using PHP
5. Import and Export Big Data using MongDB
6. Indexing in MongoDB
7. Map Reduce Using MongoDB.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS225	**Social Network Analytics**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Analyze the structure and evolution of networks
- Able to gain knowledge from disciplines as diverse as sociology, mathematics, computer science.

Course Outcomes

On successful completion of this course, the student will be able to:

- Analyze the structure and evolution of networks
- Able to gain knowledge from disciplines as diverse as sociology, mathematics, computer science.
- Understand the Online interactive demonstrations and hands-on analysis of real-world data sets.
- Understand the Online interactive demonstrations and hands-on analysis of real-world data sets.

Course Contents

UNIT-I- Introduction to Social Network **15 Hours**

Social media mining, Fundamentals, new challenges, key concepts, Good Data vs Bad Data, understanding sentiments, Sentiment Analysis, Classification, supervised social media mining, unsupervised social media mining, human sensors under honest signals.

UNIT-II-Recommendations for Social Networks **15 Hours**

Recommendation in Social Media, Challenges, Classical Recommendation Algorithms, Recommendation Using Social Context, Evaluating Recommendations.

UNIT-III- Exploring in Depth **15 Hours**

Twitter: Exploring Trending Topics, Discovering What People Are Talking About, Mining Face book: Analyzing Fan Pages, Examining Friendships, Mining LinkedIn: Faceting Job Titles, Clustering Colleagues, Mining Google+: Computing Document Similarity, Extracting Collocations.

UNIT-IV- Mining Web Pages **15 Hours**

web content mining, web structure mining, web usage mining, Natural Language Processing to Understand Human Language, Summarize Blog Posts, Mining Mailboxes, Mining GitHub, Inspecting Software Collaboration Habits, Building Interest Graphs, Mining the Semantically Marked-Up Web: Extracting Micro formats, Inference over RDF.

Recommended Learning Resources:

- Mining the Social Web, 2nd Edition Data Mining Face book, Twitter, LinkedIn, Google+, GitHub, and More By Matthew A. Russell Publisher: O'Reilly Media.
- Social Media Mining with R [Kindle Edition] NATHAN DANNEMAN RICHARD HEIMANN Maksim Tsvetovat & Alexander Kouznetsov,Social Network Analysis for Startups,Sharoof publishers,2015

Social Network Analytics Lab

The Lab component will be decided by the faculty. The lab can be done either using Python or R.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS235	**Internet of Things**	**16**	**SC**	**3**	**0**	**1**	**4**	**5**

Course Objectives

- Understand the basics of “Internet of Things” (IoT).
- Understand the need for IoT
- The elements in IoT.
- RFID as the core technologies enabling IoT.
- Sensor and sensor network as the core technologies enabling IoT.
- The key areas that can apply IoT.

Course Outcomes

- Understand the basics of IoT.
- Understand the technologies that help IoT become reality.
- Understand the programming part in IoT.
- Understand the intricacies involved in an IoT project.

Course Contents

Unit-I-Introduction to Internet of Things **15 Hours**

Definition & Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks , Communication Models , IoT Communication APIs,IoT Enabling Technologies,Wireless Sensor Networks, Cloud Computing , Big Data Analytics, Communication Protocols , RFID Basics, Embedded Systems, IoT Levels & Deployment Templates.

Unit-II-Domain Specific IoTs **15Hours**

Introduction, Home Automation, Smart Lighting,Smart Appliances , Intrusion Detection, Smoke/Gas Detectors, Cities, Smart Parking,Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment, Energy, Retail, Logistics, Agriculture,Industry, Health & Lifestyle.

Unit-III-Developing Internet Of Things **15 Hours**

IoT Design Methodology, Step 1: Purpose & Requirements Specification, Step 2: Process Specification , Step 3: Domain Model Specification , Step 4: Information Model Specification , Step 5: Service Specifications , Step 6: IoT Level Specification, Step 7: Functional View Specification, Step 8: Operational View Specification ,Step 9: Device & Component Integration, Step 10: Application Development. Case Study on IoT System for Weather Monitoring, Motivation for Using Python

Unit-IV-Advanced topics in IoT **15 Hours**

Logical Design of IOT using Python, Introduction to Python, Basics of Programming with Rasphberry PI with PYTHON, IOT Physical devices and end points. Python Packages of Interest for IoT-JSON. IoT Physical Servers & Endpoints, Introduction to cloud storage Models for IOT.

Recommended Learning Resources:

1. Internet of Things-An Hands on Approach- Vijay Madisetti (Author), Arshdeep Bahga, 2014.
2. Cuno Pfister Getting Started with the Internet of Things, OReilly, 2011.
3. Francis DaCosta, Rethinking Internet of things, Apress Open Edition, 2013
4. Adrian McEwen, Hakim Cassimally, Design of Internet of Things, 2014 John Wiley and Sons, Ltd.

IoT LAB COMPONENTS

1. Buid an ESP8266 IoT Temperature Monitor for a Balcony Garden:
   - Take a temperature reading every 10 minutes.
   - Plot it on thingspeak.com.
   - Put the Arduino to deep sleep using a watchdog timer.
   - Use the *CH_PD* pin of the ESP8266 for disabling the chip when not needed, using a *digitalWrite* on the Arduino.
2. Build a cloud-ready temperature sensor with the Arduino Uno and the IBM Watson IoT Platform: This project shows the building of a temperature sensor.It uses arduino and IOT platform
3. A Simple IoT Project with the ESP8266 WiFi module: A simple project with ESP8266 wifi module.This project collects the temperature and is displayed on the network.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS216	**Pattern Recognition**	**16**	**SC**	**3**	**1**	**0**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Study the mathematical morphology necessary for Pattern recognition.
- Introduce the student to various Pattern recognition techniques.
- Study the principles of decision trees and clustering in pattern recognition.

Course Outcomes

On successful completion of this course, the student will be able to:

- Develop and analyze decision tress.
- Design the nearest neighbor classifier.
- Develop algorithms for Pattern Recognition.
- Study the Representation and description and feature extraction.

Course Contents

UNIT-I- Introduction **15 Hours**

Introduction: What is Pattern Recognition, Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition.

Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifier, Evaluation of Clustering.

UNIT-II - Nearest Neighbor Based Classifier **15 Hours**

Nearest Neighbor Based Classifier: Nearest Neighbor Algorithm, Variants of the ANN Algorithm use of the Nearest Neighbor Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection.

Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with the NNC, Naïve Bayes Classifier, Bayesian Belief Network.

UNIT-III: Hidden Markov Models **15 Hours**

Hidden Markov Models: Markov Models for Classification, Hidden Morkov Models, Classification using HMMs.

Decision Trees: Introduction, Decision Tree for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Overfitting and Pruning, Examples of Decision Tree Induction.

UNIT-IV - Support Vector Machines **15 Hours**

Support Vector Machines: Introduction, Learning the Linear Discriminant Functions, Neural Networks, SVM for Classification.

Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers.

Recommended Learning Resources:

1. Pattern Recognition: An Algorithmic Approach: Murty, M. Narasimha, Devi, V. Susheela, Spinger Pub,1st Ed.
2. Machine Learning - Mc Graw Hill, Tom M. Mitchell.
3. Fundamentals Of Speech Recognition: Lawrence Rabiner and Biing- Hwang Juang. Prentice-Hall Pub.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS226	Bio-Informatics	14	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Give introduction to the basic practical techniques of bioinformatics.
- Study the application of bioinformatics and biological databases to problem solving in real research problems.
- Get familiar with a wide variety of internet applications, biological database and will be able to apply these methods to research problems.

Course Outcomes

On successful completion of this course, the student will be able to:

- Describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge.
- Explain the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming
- Predict the secondary and tertiary structures of protein sequences.
- Study the application of bioinformatics and biological databases to problem solving in real research problems.

Course Contents

UNIT-I-Introduction **15Hours**

Definition – Overview- Major databases in Bio Informatics- Molecular biology – Central Dogma- Data retrieval tools – Data mining of Databases – Gene Analysis – Prokaryotic and Eukaryotic Genomes – Sequence Assembly – Gene mapping – Physicalmaps – cloning – ORF – amino acids

– DNA, RNA sequences – Genetic code.

UNIT-II- DNA and Protein Sequences **15 Hours**

DNA: working with single DNA sequence : removing vector sequences- verifying restriction maps – PCR design – GC content – counting words – internal repeats – protein coding regions – OR Fing – Genome scan, Protein: predicting properties – primary structure analysis – transmembrane segments – PROSITE patterns – interpreting scanprosite results- finding domains – CD server results – pfscan results.

UNIT-III - Alignment of Pair of Sequences **15 Hours**

Terminology – Global and Local alignment Dot matrix – dynamic programming – using scoring matrices –PAM matrices – BLOSUM,Working with FASTA – Algorithm – output – E-values – Histogram, Working with BLAST –algorithm – output – services – gapped BLAST- PSIBLAST – comparison of FASTA and BLAST.

UNIT-IV- Multiple Sequence Alignment **15 Hours**

Criteria for Multiple sequence alignment –applications choosing the right sequences; FASTA, ClustalW, TCoffee methods –interpreting multiple sequence alignment – getting in right format – converting formats –using Jalview – preparing for publication.

Recommended Learning Resources:

1. S.C Rostogi , Mendiratta, P.Rostogi, “ BioInformatics: methods and applications”,second edition, PHI 2006.
2. Jean Mickel Clavere & Cadrienotredom “Bio Informatics– A beginners guide” Wiley DreamTech.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS236	Natural Language Processing	16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Learn basics of Speech technology and parsing
- Introduce the semantic analysis of speech
- Study the machine translation principles

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the Natural language processing research arena.
- Understand and work on various NLP tasks such as, POS tagging, syntactic parsing etc
- Analyze NLP applications such as, Information Retrieval systems and Machine translation system.

- Learn basics of Speech technology and parsing

Course Contents

UIT-I-Introduction **15 Hours**

Regular Expressions and Finite State Automata, Morphology and Finite State Transducers

Computational Phonology: Computational Phonology and Text to speech - N-grams: Counting words in Corpora

UNIT-II-HMMS and Speech Recognitio **15 Hours**

Speech Recognition Architecture, Overview of HMM, Advanced Methods for decoding, Training a speech Recognizer, Human Speech Recognition, Part of Speech Tagging: Rule Based, Stochastic Part-of-Speech Tagging,Transformation Based Tagging, Context Free Grammars for English, Context Free Rules and Trees, Sentence Level Constructions, Coordination Agreement, Grammars and Human Processing

UNIT-III-Parsing **15 Hours**

Parsing with Context Free Grammars, Top down Parser, Problems with Basic Top Down Parser, Finite State Parsing Methods, Representing Meaning: Computational Desiderata for Representations – Meaning Structure of Language, First Order Predicate Calculus

Semantic Analysis: Syntax driven Semantic Analysis – Attached for a Fragment of English-Integrating Semantic Analysis into the Earley Parser, Robust Semantic Analysis

UNIT-IV-Applications of NLP **15 Hours**

Applications of NLP- Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.
Machine Translation Overview

Recommended Learning Resources:

1. D. Jurafsky and J. Martin , “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2004

2. C. Manning and H. Schutze , “Foundations of Statistical Natural Language Processing”, Massachusetts Institute of Technology, 2003.

3. James Allen “Natural Language Understanding” ,The Benajmins/Cummings Publishing Company Inc. 1994.

4. Steven Bird,Ewan & Edward Loper,Natural Language Processing with Python,Shroff publisher.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS217	**Big Data Security**	**16**	**SC**	**3**	**1**	**0**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Understanding significance of privacy, ethics in big data environment
- Analyzing the steps to secure big data
- Building security in Hadoop environment and its ecosystem.
- Analyzing data security and event logging

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the significance of privacy, ethics in big data environment
- Analyze the steps to secure big data
- Build security in Hadoop environment and its ecosystem.
- Analyze data security and event logging

Course Contents

UNIT-I: Big Data Privacy, Ethics and Security 15Hours

Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self-regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security.

UNIT-II-Security, Compliance, Auditing, and Protection 15 Hours

Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems.

UNIT-III-Hadoop Ecosystem Security 15 Hours

Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop

UNIT-IV-Data Security & Event Logging 15 Hours

Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in hadoop cluster

Recommended Learning Resources:

1. Mark Van Rijmenam, "Think Bigger: Developing a Successful Big Data Strategy for Your Business", Amazon, 1 edition, 2014.
2. Frank Ohlhorst John Wiley & Sons, "Big Data Analytics: Turning Big Data into Big Money", John Wiley & Sons, 2013.
3. herif Sakr, "Large Scale and Big Data: Processing and Management", CRC Press, 2014.
4. udeesh Narayanan, "Securing Hadoop", Packt Publishing, 2013.
5. Ben Spivey, Joey Echeverria, "Hadoop Security Protecting Your Big Data Problem", O'Reilly Media, 2015.
6. Top Tips for Securing Big Data Environments: e-book (http://www.ibmbigdatahub.com/whitepaper/top-tips-securing-big-data-environments-e-book)
7. http://www.dataguise.com/?q=securing-hadoop-discovering-and-securing-sensitive-data-hadoop-data-stores
8. Gazzang for Hadoop http://www.cloudera.com/content/cloudera/en/solutions/enterprise-solutions/security-for-hadoop.html
9. eCryptfs for Hadoop https://launchpad.net/ecryptfs.
10. Project Rhino - https://git
b.com/intel-hadoop/project-rhino/

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS227	**Deep Learning**	**16**	**SC**	**3**	**1**	**0**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Understand the basic theory underlying deep learning.
- Formulate deep learning problems corresponding to different applications.
- Introduce deep learning algorithms to solve problems of moderate complexity.

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand what is learning and why it is essential to the design of intelligent machines.
- Design and implement various machine learning algorithms in a wide range of real world applications.
- Acquire knowledge deep learning and be able to implement deep learning models for language, vision, speech, decision making, and more
- Understand a range of deep learning algorithms along with their strengths and weaknesses.

Course Contents

UNIT-I-Complex Systems & Artificial Life **15 Hours**

Complex Systems and Artificial Life - Complex Networks - Self-Organization and Emergent Complex Behavior - Cellular Automata - Boolean Networks -Development and Morphogenesis - Open-ended evolution.

UNIT-II-Natural Computation and Neural Networks **15 Hours**

Biological Neural Networks- Artificial Neural Nets and Learning – pattern classification & linear separability - single and multilayer perceptrons, backpropagation - associative memory - Hebbian learning - Hopfield networks - Stochastic Networks – Unsupervised learning

UNIT-III-Evolutionary Systems and Algorithms **15 Hours**

Evolutionary Programming: biological adaptation & evolution – Autonomous Agents and Self-Organization: termites, ants, nest builiding, flocks, herds, and schools. Genetic algorithms: Schema theorem.

UNIT-IV-Competition, Cooperation and Swarm Intelligence **15 Hours**

Collective Behavior and Swarm Intelligence - Social Insects - Stigmergy and Swarm Intelligence; Competition and Cooperation - zero- and nonzero-sum games - iterated prisoner’s dilemma - stable strategies - ecological & spatial models - Communication and Multi-Agent simulation – Immuno-computing.

Recommended Learning Resources:

1. Leandro Nunes De Castro, Fernando Jose Von Zuben, "Recent Developments in Biologically Inspired
2. Computing", Idea Group Publishing, 2005.
3. Leandro Nunes De Castro , "Fundamentals of Natural Computing: Basic concepts, Algorithms and
Applications", Chapman & Hall/ CRC Computer & Information Science Series, 2006.
4. Dario Floreano, Claudio Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", MIT Press, 2008.
5. Nikhil Buduma with contributions by Nicholas Locascio, Fundamentals of Deep Learning, Shroff Publishers,2017.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS237	**Data warehousing and Business Intelligence**	**16**	**SC**	**3**	**1**	**0**	**4**	**5**

Course Objectives

The objectives of this course are to:

- Be exposed with the basic rudiments of business intelligence system
- understand the modeling aspects behind Business Intelligence
- understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

Course Outcomes

On successful completion of this course, the student will be able to:

- Explain the fundamentals of business intelligence.
- Link data mining with business intelligence.
- Apply various modeling techniques.
- Decide on appropriate technique.

Course Contents

Unit-I-Technical-Architecture **15 Hours**

Technical architecture introduction , Back room architecture , Presentation server architecture , Front room architecture – Infrastructure – Metadata , Security

Dimensional Modeling

Making the case for dimensional modeling, Dimensional modeling primer, Enterprise data warehouse bus architecture – Updates to the dimension tables , Miscellaneous dimensions , The snowflake schema

Unit-II-Designing the Dimensional Modeling **15 Hours**

Modeling process overview , Getting organized , Four step modeling process , Design the dimensional model -Embrace data stewardship , Extract, Transform and Load overview , Extract, Transform and Load requirements and steps , Data extraction , Data transformation , Data loading.

Unit-III-Business Intelligence Applications **15 Hours**

Importance of business intelligence applications , Analytical cycle for business intelligence , Types of business intelligence applications , Navigating applications via the business intelligence portal.

Unit-IV-Designing and Developing Business Intelligence Applications **15 Hours**

Business intelligence application resource planning , Business intelligence application specification , Business intelligence application development , Business intelligence application maintenance.

Measures, Metrics, KPIs, and Performance Management

Understanding Measures and Performance; Measurement System Terminology; Navigating a Business Enterprise, Role of Metrics, and Metrics Supply Chain; "Fact-based Decision Making" and KPIs; KPI Usage in Companies; Where Do Business Metrics and KPIs Come From? Connecting the Dots: Measures to Business Decisions and Beyond

Recommended Learning Resources:

1. Raiph Kimball-Ross, The Data Warehouse Lifecycle Toolkit, Wiley Publication, 2008.
2. Ponniah, Data Warehousing Fundamental, Wiley Publication, 2010.

THIRD SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern L	T	P	Credits	Working Hours
1.	MS17CS301	Open Elective	OE	3	1	0	4	5
2.	MS17CS312	Mobile n/w and computing	SC	3	1	0	4	5
	MS17CS322	Object Oriented Software Engineering						
	MS17CS332	IT Security						
3.	MS17CS313	Multivariate Methods for Data Analysis	SC	3	1	0	4	5
	MS17CS323	Stochastic Decision Science						
	MS17CS333	Advanced Web Technologies						
4.	MS17CS304	Minor Project / Internship	HC	1	1	6	8	15
Total Credits				**10**	**3**	**6**	**2**	**25**

Course Code	Mobile N/W and computing	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS312		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Explain the major concepts and techniques in the field of mobile computing.
- Describe the 2G and 3G communication systems
- Describe Mobile IP and Mobile TCP.
- Describe basic concepts of Pervasive Computing**.**

Course Outcomes:

On successful completion of this course; the student will be able to:

- Understand Bluetooth, 2G, 3G, Wi-Fi, WiMAX, Mobile IP, IrDA and ZigBee protocols.
- Realize mobile device data security, mobile ad-hoc and wireless sensor networks.
- Understand Handoff in wireless mobile networks and basic concepts of Pervasive Computing**.**
- Explain the Security in mobile computing, Handoff in wireless mobile networks

Course Contents:

Unit-I-Mobile Computing Environment 15 Hours

Functions-architecture-design considerations, content architecture –CC/PP exchange protocol, context manager. Data management in WAE-Coda file system-caching schemes-Mobility QOS, Security in mobile computing.

Unit-II-Handoff in wireless mobile networks 15 Hours

Reference model handoff schemes. Location management in cellular networks-Mobility models-location and tracking management schemes-time, movement, profile and distance based update strategies.ALI technologies.

Unit-III - Wireless transmission 15 Hours

Frequencies for radio transmission, Signals, Signal propagation, Multiplexing, Modulation, Cellular systems

Telecommunications systems GSM, CDMA,LTE,(2G,3G,4G),DECT, TETRA, UMTS and IMT-2000,Bluetooth.

Broadcast systems: Overview, Cyclical repetition of data, Digital audio broadcasting,Multi-media object transfer protocol, Digital video broadcasting, Convergence of broadcasting and mobile communications

Unit-IV **15 Hours**

Basic Security Concepts; GSM and UMTS Security and Attacks; Vulnerabilities in Cellular Services. Cellular Jamming Attacks and Mitigation Security in Cellular VoIP Services.

Recommended Learning Resources:

1. Ivan Stojmenovic, Handbook of Wireless Networks and Mobile Computing, John Wiley & Sons Inc., Canada, 2002, Mobile Communications J. Schiller, Pearson education publishing 2003
2. Asoke K Taukder, Roopa R Yavagal, Mobile Computing, Tata McGraw Hill, New Delhi, 2005.
3. SengLoke,Context-Aware Computing Pervasive Systems, Auerbach Pub.,Newyork,2007.
4. UweHansmannetl, Pervasive Computing, springer, Newyork, 2001.
5. F. Adelstein, K.S. Gupta, Golden G. Richard, and Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, McGraw-Hill, 2005.
6. NoureddineBoudriga, Security of Mobile Communications, CRC Press, 2010.
7. L. Buttyán and J. Hubaux, Security and Cooperation in Wireless Networks, Available online at secowinet.epfl.ch/fulltext/SeCoWiNetV1.5.1.pdf

Course Code	Object Oriented Software Engineering	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS322		14	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Apply software engineering theory, principles, tools and processes, as well as the theory and principles of computer science and mathematics, to the development and maintenance of complex, scalable software systems.
- Design and experiment with software prototypes
- Select and use software metrics
- Communicate effectively through oral and written reports, and software documentation

Course Outcomes

On successful completion of this course, the student will be able to:

- Apply knowledge of mathematics, science, and engineering.
- Design and conduct experiments, as well as to Analyze and interpret data.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, safety, and sustainability.
- Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

Course Contents

UNIT I - Introduction **15 Hours**

System Development as industrial process – System life cycle – Object Orientations – Object

Oriented System Development – Object Oriented Programming.

UNIT II- Model Architecture **15 Hours**

Architecture – Model building – Model architecture – requirements model – analysis model – Design Model – Implementation Model – Test Model.

UNIT III – Model Analysis **15 Hours**

Analysis – Requirements Model – Analysis Model. Construction – Design Model – Block Design – Working with construction.

UNIT IV- Model Classification **15 Hours**

Real Time Specialization – Classification – Analysis – Construction – Testing – Verification – Data specilization – ODBMS – Components Definition – Use – Management – Testing unit testing – integration testing – system testing – process.

Recommended Learning Resources:

1. Ivar Jacobson, "Object –Oriented Software Engineering", Pearson Education, Delhi, 2002.
2. Roger S. Pressman, "Software Engineering", Fifth Edition, McGraw-Hill Internal Edition, Singapore, 2001.

Course Code	IT Security	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS332		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Understand essential concepts for cyber & IT security,
- Get Knowledge of cyber security applications, cyber crimes, unauthorized crimes and hacking.
- Study prohibited action on cyber policies, evaluation of crime scene, evidence collection, cyber security law and policies.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Understand cyber security applications and principles.
- Analyse about cyber-crimes and Email frauds.
- Understand prohibited action on IPR violations, prevention of forgery and card related crimes.
- Understanding the forensic tool and evidence collection.

Course Contents:

UNIT-I - Introduction to information systems **15 Hours**

Introduction to information systems, Types of information Systems, Development of

Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

UNIT-II - Application security **15 Hours**

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, AccessControl. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-CommerceElectronic Payment System, e• Cash, Credit/Debit Cards. Digital Signature, public Key Cryptography.

UNIT-III - Developing Secure Information Systems **15 Hours**

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

UNIT-IV - Security Policies **15 Hours**

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

Recommended Learning Resources:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, “Analysing Computer Security ”, Pearson Education India.
2. V.K. Pachghare, “Cryptography and information Security”, PHI Learning Private Limited, Delhi India.
3.Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla ,”Introduction to Information Security and Cyber Law” Willey Dreamtech Press.
4. Schou, Shoemaker, “ Information Assurance for the Enterprise”, Tata McGraw Hill.

Course Code	Multivariate Methods for Data Analysis	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.

MS17CS313		**14**	**SC**	**3**	**1**	**0**	**4**	**5**

Course Objectives:

The objectives of this course are to:

- Introduce the students into the field of Multivariate Techniques for analyzing large volumes of data and to take decisions based on inference drawn.
- Data characteristics and form of Distribution of the Data Structures
- Understanding the usage of multivariate techniques for the problem under the consideration
- Draw valid inferences and to plan for future investigations.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Apply the concepts in the field of Multivariate Techniques for analyzing large volumes of data and to take decisions based on inference drawn.
- Analyse Data characteristics and form of Distribution of the Data Structures
- Apply the usage of multivariate techniques for the problem under the consideration
- Draw valid inferences and to plan for future investigations.

Course Contents:

UNIT I - Introduction to Multivariate Analysis **15 Hours**

Meaning of Multivariate Analysis, Measurements Scales - Metric measurement scales and Non-metric measurement scales, Classification of multivariate techniques (Dependence Techniques and Inter-dependence Techniques), Applications of Multivariate Techniques in different disciplines.

UNIT II – Factor Analysis **12 Hours**

Factor Analysis: Meanings, Objectives and Assumptions, Designing a factor analysis, Deriving factors and assessing overall factors, Interpreting the factors and validation of factor analysis.

UNIT III – Cluster Analysis **13 Hours**

Cluster Analysis: Objectives and Assumptions, Research design in cluster analysis, Deriving clusters and assessing overall fit (Hierarchical methods, Non Hierarchical Methods and Combinations), Interpretation of clusters and validation of profiling of the clusters.

UNIT IV - Discriminant Analysis & Linear Programming **20Hours**

Discriminant Analysis- concept, objective and applications. Procedure for conducting discriminant analysis. Stepwise discriminate analysis and Mahalanobis procedure. Logit model.
Linear Programming **:** Linear Programming problem - Formulation, graphical method, simplex method. Integer Programming. Transportation and Assignment problem.

Recommended Learning Resources:

1. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
2. T. W. Anderson , “An Introduction to Multivariate Statistical Analysis, 3rd Edition”, Wiley, 2003.
3. William r Dillon, John Wiley & sons, “Multivariate Analysis methods and applications”, Wiley, 1984.
4. Naresh K Malhotra, Satyabhusan Dash, “Marketing Research An applied Orientation”, Pearson, 2011.
5. Hamdy A Taha, “Operations Research”, Pearson, 2012.
6. S R Yaday, A K Malik, “Operations Research”, Oxford, 2014.

Course Code	Stochastic Decision Science	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS323		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering.
- Introduce students to the basic methodology of “probabilistic thinking” and to apply it to problems;
- Understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
- Analysis of random process and application to the signal processing in the communication system.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Compute simple probabilities using an appropriate sample space.
- Apply simple probabilities and expectations from probability density functions (pdfs)
- Analyse Least -square & maximum likelihood estimators for engineering problems.
- Project Mean and covariance functions for simple random processes.

Course Contents:

Unit I: Random Variables and their Probability Distributions 15 Hours

Random Variables: Probability distribution function - probability density function - conditional probability - statistical independence - Bayes formula; Moments of random variables: Expected value and moments - mean and variance of random variable – coefficients of variation - skewness and kurtosis - moments - covariance and correlation coefficient - mean and variance of sum and product of two random variables - conditional mean and variance - application of conditional mean and variance.

Unit II: Discrete Random Variables and their Distributions 15 Hours

Moment Generation Function: Characteristics function - cumulants - probability generating function - binomial distribution - negative binomial distribution - hypergeometric distribution - multinominal - Poisson distributions - relationship between various discrete type distributions.

Unit III: Transformation of Random Variables 15 Hours
Transformation of Single and Several Random Variables: Function of random variables – sum - differences - product and ratio of two random variables - transformation through characteristic functions.

Unit IV: Stochastic Processes 15 Hours
Introduction: Classification of stochastic process - stationary process (SSS and WSS) - ergodic process - independent increment process - Markov process - counting process - narrowband process - normal process - Wiener Levy process - Poisson - Bernoulli – shot noise process - autocorrelation function.

Recommended Learning Resources:

1. Michel K. Ochi, "Applied Probability and Stochastic Processes", John Wiley and Sons, 2008.
2. Paboulis A., "Probability, Random Variables and Stochastic Processes", Tata McGraw Hill, 1984.
3. Kishor S. Trivedi, "Probability and Statistics with Reliability Queuing and Computer Science Application", John Wiley and Sons, 2002.

Course Code	Advanced Web Technologies	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS333		14	SC	3	1	0	4	5

Course Objectives:
The objectives of this course are to:
- Learn the concepts of server programming by using PHP
- Understand the use of Java servlets

Course Outcomes:
On successful completion of this course; the student will be able to:

- Design a server side webpage by using PHP
- Use Java servlets
- Use the concepts of RDF
- Understand the RDF and Semantic Web

Course Contents:

UNIT I - Introduction to PHP 15 Hours
Introduction to PHP, Language Features. PHP Basics, PHP's Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Functions, Arrays, Strings and Regular Expressions, Working with the File and Operating System.

UNIT II - Introduction to Java Servlets 15 Hours

Introduction to Java Servlets, Static and Dynamic contents, Servlet life Cycle and Life cycle methods, Servlet Request and Response Model, Deploying a Servlet, Servlet State Transitions, Servlet Config and Servlet Context, Servlet Redirection and Request Dispatch, Servlet Synchronization and Thread Model. Maintaining Client State: Cookies, URL rewriting, Hidden form fields, Session Tracking.

UNIT – III - Introduction to Semantic Web **15 Hours**

Introduction to Semantic Web: Web, Web 2.0, Syntactic Web, Web 3.0 and Semantic Web; why Semantic Web; Impact of Semantic Web; Myths about Semantic Web; Semantic Modeling. Overview of Web and XML technologies

UNIT – IV - NodeJS **15 Hours**

NodeJS: Basics, Node.js Global, Node.js Process, Modules and Require in Node.js, Core Node.js Modules, Node.js Module Patterns, Node.js Command-Line Interface Arguments, Running Node.js Scripts, Node.js Shell (REPL), Node.js File System Module.

Recommended Learning Resources:

1. Holzner, Steven. *PHP: the complete reference*. Tata McGraw-Hill Education, 2007.
2. Hall, Marty, Larry Brown, and Yaakov Chaikin. *Core Servlets and JavaServer Pages, Volume 2: Advanced Technologies*. Pearson Education, 2007.
3. Nandini, Dhana. "Semantic Web And Ontology-eBooks and textbooks from bookboon. com." (2014).
4. Cantelon, M., Harter, M., Holowaychuk, T. J., & Rajlich, N. (2014). Node. js in Action (pp. 17-20). Manning.

Fourth Semester

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS304	**Minor Project / Internship**	**14**	**HC**	**1**	**1**	**6**	**8**	**15**

Guide Lines

Project survey has to be completed and problem identification for the project must be done. Students must meet the guide and discuss with due PPT presentations at least two hours per Wk. and do the necessary ground work for Phase II devoting at least 6 hours per Wk..

- The project should be inter disciplinary
- Team size should be of max ***one*** members
- Use any version control software
- Project should be of Research Based
- Proper and meaningful reports should be generated by making use of latest reporting tools
- Project report should follow standard template with the following contents:
    a) Abstract
    b) Introduction to project
    c) Literature Review
    d) Basic Diagrams like (DFD, ER, Class diagram, etc..)
    e) Methodology
    f) Result Analysis
    g) Concussion
    h) Future enhancement
    i) Bibliography
- project reports should be submitted for evaluation

CAREER COUNSELING AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

- Willingness to learn
- Self motivation
- Team work
- Communication skills and application of these skills to real scenarios
- Requirement of gathering, design and analysis, development and testing skills
- Analytical and Technical skills
- Computer skills
- Internet searching skills
- Information consolidation and presentation skills
- Role play
- Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full- fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality. The need of the hour in the field of Commerce is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career.

The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The various skill/certification programs identified are as follows:

- Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX
- Red-hat certified programs on LINUX,
- Management related programs like SAP,ERP and Business Analytics
- Open Source software/hardware, Software Testing
- Advanced networking based CISCO / Microsoft technology.
- Web designing, System administration
- IBM certified programs.

The University has signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

LIST OF FACULTY MEMBERS

	Dr. S. Senthil, Associate Professor and Director has completed his B.Sc (Applied Sciences – Computer Technology) from P.S.G College of Technology, MCA from Bharathidasan University, M.Phil in Computer Science from Manonmaniam Sundaranar University and Ph.D in Computer Science from Bharathiar University. He has passed State Eligibility Test conducted by Bharathiar University. While he has an experience of 18 years in teaching, his areas of interest are RDBMS, Data Mining, Data Compression, Computer Networks and Data Structures. He has published 30 papers in various National and International Journals of repute. He has presented a paper entitled "Lossless Preprocessing Algorithms for better Compression" in an IEEE International Conference at Zhangjiajie, China. He was also the recipient of the best paper awards, at an International Conference on “Wisdom Based Computing” at Thiruvananthapuram and at a National Conference on “Transforming India through Digital Innovations” at Guru Shree Shantivijai Jain College for Women, Chennai. (Email Id-dir.csa@reva.edu.in)
	Dr. M. Vinayaka Murthy, Professor, School of Computer Science and Applications, Having secured Ph. D. in "Computational Fluid Dynamics - Mathematics" from Bangalore University, M.Sc. in Mathematics, B.Sc. in Mathematics from Bharathidasan University and B. Ed. degree in Mathematics from Annamalai University, he has 26 years of teaching experience in UG, PG and Ph.D, teaching various subjects like Discrete Mathematics, Probability and Statistics, Operations Research, System Simulation and Modelling, Finite Automata Theory, Analysis and Design of Algorithms, Computer Graphics, Data Mining & Data Warehousing, Numerical Methods, Mathematics, Basic Mathematics and Research Methodology. He is recognized as a Research guide in computer Science in the University of Mysore, VelTech University and REVA University. He has published more than 45 research papers in reputed journals and conferences. He is interested in guiding research scholars in the field of Data Mining and image processing. Presently he is guiding 8 PhD scholars. (Mobile:(+91)9448809443;emailids:dr.m.vinayakamurthy@gmail.com,vinayaka murthy@reva.edu.in).
	Prof. Lokesh C.K., Associate Professor , Deputy Director and Coordinator-BCA in School of Computer Science and Application hold MCA, M Sc, M Phil. He has 17 years of the teaching experience. He is serving as Head of the Department of Computer Science for 9 years in REVA Institute of Science and Management. He has served as a member of BOE, Bangalore University, CMR Institute of Management Studies, Maharani Lakshmi Ammani College for women and Jain Group of Institutions, Bengaluru. (Email Id- lokeshck@reva.edu.in)

	Dr. Rajeev Ranjan, Associate Professor , Assistant Director and Co-ordinator – MCA & MS completing post-graduation from Uttar Pradesh Technical University (UPTU), Lucknow, has worked as a Software Engineer at SoftElixir, New Delhi. Later he joined Indian Institute of Information Technology-Allahabad (IIIT-Allahabad) as Junior Research Fellow (JRF), followed by Research Associate (RA). He has joined as an Associate Professor at REVA University after completing his Ph.D at IIITA. He has published about 11 papers in International and National journals and conferences of repute and is the author of 02 book chapters. He has 10 years of experience in industry and academics. His area of work includes-: Wireless sensor networks- coverage & connectivity, Sensor deployment and localization, Wireless sensor statistical routing etc. (Emailid : rajeevranjan@reva.edu.in)
	Prof. K. Vijayalakshmi, Associate Professor and Assistant Director , School of Computer Science & Applications holds M.Phil. in Computer Science from MS University, MCA from Bharathidasan University and B.Sc. in Mathematics from Bharathiar University. She has 16 years of teaching experience, teaching various subjects like C Programming, Data Structures, OOPs Concepts using C++, Computer Networks, Software Engineering, Management Information System, Simulation Modeling and Design, and Data Mining. She has presented and published papers in National Level Conferences and International Journals. She is pursuing research in Data Mining. . (Email ID- kvijayalakshmi@reva.edu.in)
	Prof. D. Revina Rebecca, Associate Professor, School of Computer Science and Applications, holds M.Phil degree in “Computer Science” and M.C.A Degree from Madurai Kamaraj University. She has 20 years of teaching experience, teaching various subjects like NoSQL, Database Management System, Data Mining, Multimedia, Cloud Computing, Computer Organization, System Software, Communication Skills, COBOL. She is pursuing research in Cloud Computing. (Email ID- revinarebecca@reva.edu.in)
	Prof. Prasanna Kumar R.B. Associate Professor in School of Computer Science and Application. Educational Qualification: MCA. He is working in this reputed institution REVA ISM from last Eight years as a Associate Professor in Computer Science department, and He has more than 16 years of experience in the field of education. He was a BOE for Exams of 2012-13, Bangalore University for BSc (CS) Program. He was a Deputy Custodian for BA Valuation Unit, Bangalore University for the academic 2014-15. (Email Id - prasannakumarrb@reva.edu.in)
	Prof.Sasikala G, holds MCA,MBA and B.Com. (Computers) from Sri Venkateswara University. She has 12 years of teaching experience, teaching various subjects like C Programming, Unix Programming, Operating Systems, OOPs Concepts using C++, Data Structures, Advanced web Programming, .Net, Network Security, and Cloud computing. She has presented and published papers in National Level Conferences and International Journals. She is pursuing research in Network Security. (Email id : sasikalag@reva.edu.in)

	Prof. Ravi Dandu has completed MCA from VTU. He has 10 years of academic experience, teaching various subjects like C Programming, Unix Programming, Operating Systems, JAVA, Advanced web Programming, J2EE, Compiler Design and Cloud computing. He is interested in Network Security. (Email id :ravi_d@reva.edu.in)
	Prof. PinakaPani R, Assistant Professor, School of Computer Science and Applications, holds M.C.A degree from Sri Venkateswara University (SVU), Tirurpati. He has 09 years of teaching experience and one year in IT Industry. He is teaching Data Structures, Object Oriented Programming with C++, JAVA, Database Management Systems, Software Testing, Management Information Systems, Information and Network Security, Advanced Computer Networks. His area of research interest is Industrial Drives. (Email ID- pinakapanir@reva.edu.in)

	Prof. M.Ranganathappa, Assistant Professor, School of Computer Science and Applications, completed MCA from Sri Venkateswara University and B.Ed. in Physics and Mathematics from Bangalore University. He has 9 years of teaching experience in Discrete Mathematics, System Simulation Modeling, Web Programming, Problem Solving using C, Object Oriented Programming using C++, Database Management Systems, Data Structures, Data Warehousing and Data mining, Operating Systems and Fundamentals of Computer Organization. (Email Id- ranganathappam@reva.edu.in)
	Prof. Krishnamurthy R, Assistant Professor in School of Computer Science & Applications holds B.E. in Computer Science & Engineering from Mysore University, pursuing M. Tech (CSE) from VTU. Prof. Krishnamurthy R has 20 years of teaching experience in Computer Science. He has served as a member of BOE, Kuvempu University, CMRIMS college. His areas of interest are Big data, Pervasive Computing, Data Analytics. (Email Id- krishnamurthyr@reva.edu.in)
	Prof. Parthasarathi M, Assistant Professor, School of Computer Science and Applications completed MCA from Thiruvalluvar University and B.Sc.in Computer Science from Madras University. He has 10 years of teaching experience, teaching various subjects like Data Structures, Analysis and Design of Algorithms, .NET, Computer Graphic. His area of interest research is Industrial Drives. (Email ID- parthasarathym@reva.edu.in)

	Prof. Vijaya Kumar H, Assistant Professor, School of Computer Science and Applications, completed MCA from VTU, Belgaum and B. Sc. in Computer Science, Electronics and Mathematics from Kuvempu University, Shimoga. He has 7.10 years of teaching experience, teaching various subjects like UNIX programming, Data communication &Computer Networks, COBOL Programming, Fundamentals of computer organization, Software Engineering, Principles of User Interface Design, Operating Systems, Statistical Methods, Cryptography and network security and Shell scripting, Network simulator-2 with TCL Script. He is interested in pursuing research in Industrial Drives. . (Email ID- vijayakumarh@reva.edu.in)
	Prof. Vijayalaxmi P Chiniwar, Assistant Professor, School of Computer Science and Applications, holds MCA degree from VTU. She has 7.5 years of teaching experience. She has published 1 research paper in National Conference. She is teaching various subjects like C, C++, JAVA, Data Structures, Operating Systems, System Software, Unix, and Professional communication and Ethics (Email ID- chiniwarvijaya@reva.edu.in)

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REVA UNIVERSITY
Bengaluru, India

(School of Applied Sciences)
M.Sc. Biochemistry
HANDBOOK
2017

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Rukmini Educational Charitable Trust

A Unit of DivyaSree

MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju
Chancellor
REVA University

Education during recent years has witnessed a great transformation. Today's society, termed as "Knowledge Society" has brought about unprecedented economic and social growth. This has propelled universities across the world to devise new ways of tapping human potential for different competencies and building a vibrant society with a win-win situation for all.

REVA University has seen the light of the day to imbibe this character of paradigmshift in academic pursuits to contribute to the knowledge society. REVA works hard to bring in you an exciting and rewarding educational experience, to discover new interests that will develop your career prospects. You will benefit from a unique approach to student-entered learning through group work and individual study tackling real world challenges alongside experienced practitioners and researchers.

REVA has excellent learning facilities including custom built teaching facilities designed specifically to emulate working conditions, air-conditioned library opened for your studies from early morning till midnight and facilities for variety of sports and cultural activities.

Our faculties have introduced socially relevant and market driven commerce courses after studying the market situation in detail and consulting entrepreneurs, experts in different areas of commerce and industry and other stake-holders. I am glad that the Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) being adopted will facilitate learning environment under continuous guidance and monitoring by the faculty and equip you with competent skills apt for different job prospects across the globe.

I hope that the present scheme of instructions, continuous periodic progress assessments, course curriculum of MSc Biochemistry program and other information provided in this hand book will guide you to choose appropriate courses of study and move ahead in the right direction in your chosen area of study. I hope you will enjoy and experience the curriculum, the student-centred teaching and learning ambience in developing your personality to become successful professionals, entrepreneurs and proud citizens of the country. I wish you every success in your career.

MESSAGE FROM THE VICE-CHANCELLOR

Higher education across the globe is opening doors of its academic disciplines to the realworld experiences. The disciplinary legitimacy is under critical review. Trans-border mobility and practice learning are being fore-grounded as guiding principles. Interactive learning, bridging disciplines and facilitating learners to gain different competencies through judicious management of time is viewed as one of the greatestand fascinating priorities and challenges today.

All the programs in REVA University are designed with a great care keeping in view of present requirements and job opportunities. Experts in respective areas of study from primary institutions, industries, research organizations, business sectors and such others have been involved in designing the curriculum of each program.

The L: T: P structure of teaching and learning under Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) would certainly help our students learn and build competencies needed in this knowledge based society.It provides students an opportunity to choose subject(s) of interest in other areas of study and learn courses with students of different subjects and also facilitates cross cultural learning. It further facilitates students to move in fast track and earn additional certificates and diploma.

The well qualified, experienced, committed teachers in REVA University will involve students in integrative learning and application environment within and outside the University. They will certainly mould them with knowledge, skill and ethical values and empower them to face the competitive world with courage and confidence.

This handy document containing brief information about MSc Biochemistry, scheme of instructions, course content, CBCS-CAGP regulations, its advantages and calendar of events for the year will serve as a guiding path to students to move forward in a right direction. It is for the students to be disciplined, committed, to work hard, make use of enormous resources and take guidance from expert facultiesto accomplish all round development of their personalities and succeed with flying colours not only in earning degree but also in their future career as leaders and proud citizens of Mother India.

Dr. S Y Kulkarni
Vice-Chancellor

MESSAGE FROM THE DIRECTOR - FACULTY OF SCIENCE

The curriculum of an Institution of higher learning is a living entity. It evolves with time, reflects the ever hanging needs of the society and keeps pace with the growingtalent of the students and the faculty. The curriculum of the M.Sc. Biochemistry program of REVA University is no exception.

An experience of a decade in preparing graduates and postgraduates in engineering, architecture, law, commerce and science for a wide variety of industries & research organizations has led to creation of the new curriculum. I sincerely believe that it will meet the aspirations of all stake holders – students, faculty and the employers of REVA University

The curriculum has been designed in such a way that the teacher enjoys freedom to expand it in any direction he feels appropriate and incorporates the latest knowledgeand stimulates the creative minds of the students. There is also provision for new experiments with new contents and new techniques. This is going to lead to new teaching – learning paradigm with experiential, experimental & industry relevant approaches. The present curriculum is contemporary because it is culmination of efforts of large number of faculty members, experts from industries and research level organizations. An effort of benchmarking this curriculum with curriculum of other institutions of repute like NITs and IITs has been done.

I am very sure that all students of REVA University enjoy this curriculum and take fullest advantage to expose themselves to fundamentals and applications. Also, imbibe all attributes that are required to term them as Global Engineers. The innovativeness and creativity being introduced should be explored fully by our students.

The flexibility in the curriculum permits staff and students to incorporate changes in terms of addition of new courses and deletion of irrelevant courses keeping the rapid advances in the technology into consideration.

The curriculum caters to and has relevance to local, regional, national, global developmental needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

I also record my personal gratitude to Chancellor, Vice-Chancellor and members of Academic Council who have lent every bit of their wisdom to make this curriculum truly superior.

Dr. N. Ramesh,
Director, Faculty of Science

PREFACE

M.Sc Biochemistry conceived by REVA University is an intensive intellectually challenging programme expect to acquire many transposable skills, allows studentsto gain research and industrial experience in contemporary Biochemistry. The curriculum covers Core courses with good number of electives in the final year. The electives include the area of General/Applied Biochemistry, Food Technology and Computational Biology. Short term training, Internships, Student Projects in Biochemistry, Clinical Research, SAS, Clinical Diagnostics provide opportunity for the students to choose their area of interest and eligibility criteria.

The students may also choose fast track learning and acquire additional Proficiency Certificate or Diploma in addition to the curriculum. Interactions with Industries, Diagnostic Laboratories, and Research Institutes are made through Industrial visits, Internships, Training programs and MOUs.

Collaborations with Research Institutes / Industries

- FRLHT-The Trans disciplinary University
- CIMAP- CSIR Laboratory
- CIFT & other Central Institutes
- Himalaya Drug Company
- Clinical Research Institutes

Such collaborations will help a student to compete in employment and research to recognize them as Research Scholars, Scientists in reputed Chemical, Biological, Healthcare, Pharmaceutical, Agriculture, Petrochemicals, Cosmetics, Food Industries, Clinical data management and Diagnostic Laboratories.

Prof.Jayashree S

Head, School of Biochemistry

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart quality education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. The Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Law, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies, (RIMS) REVA Institute of Education,(RIE) REVA First Grade College,(RFGC) REVA Degree College (Evening), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and REVA University. Through these institutions, the Trust seeks to fulfill its vision of providing world class education and create abundant opportunities for the youth of thisnation to excel in the areas of Engineering, Commerce, Management, Architecture, Law,Education, Arts and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and Ph.D degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 10,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University established under the Government of Karnataka Act 80 of the year 2012 and notified in the Karnataka Gazette dated 7th Feb, 2013, is located 14 kms away from the Bangalore International Airport on the way to Bangalore city. The university has a sprawling lush green campus spread over 41 acres of land equipped with state-of-the-art infrastructure and conducive environment for higher learning.

The REVA campus has well equipped laboratories, custom-built teaching facilities designed specifically to emulate working conditions, fully air-conditioned library and central computer centre kept open from morning 8.00 AM till mid-night for the students and the faculty. The well planned sports facility for variety of sports activities, facilities for cultural programs and friendly campus lifestyle add to the overall personality development of students. The campus also has residential facility for students, faculty and staff.

Currently, REVA University offers 23 Post Graduate programs and 17 Graduate programs in Engineering and Technology, Science, Commerce & Management and Humanities in addition to research degrees leading to Ph.D in different disciplines. The University aims to offer many more PG and UG programs in Science, Arts, Commerce, Engineering & Technology, Management Studies, Education and Humanities in the years to come.

The programs being offered by REVA University are well planned and designed after detailed study in emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Grading Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under fast track for those who have the capabilities to surpass others.
These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVAUniversity has also initiated many supportive measures such as bridge courses, specialcoaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, businessfirms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

SCHOOL OF BIOCHEMISTRY

- The School of Biochemistry offers graduate, post graduate and PhD programs.
- The course trains students to acquire knowledge and skills in the field of General, Industrial and Clinical Biochemistry applicable to Industry, Research and Development laboratories

Vision

To impart contemporary knowledge in various socially relevant disciplines to students and transforming them to become global citizens by nurturing intellect, creativity, character and professionalism.

Mission

To achieve excellence through pedagogy, support interface between industry and academy through research in order to help students achieve creative and professional outlook to make them global citizens.

Objectives:

- Impart need based, practical education and global competence in contemporary biological sciences in accordance with the vision of REVA University.
- Provide an advanced understanding of the core principles of Biochemistry and their experimental basis.
- Enable students to acquire specialised knowledge and understanding of selected aspects by means of series of lectures.
- Foster growth, innovation, research and to promote entrepreneurship.
- Publish research papers in peer reviewed journals.

VALUE SYSTEM

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Team-work

External Advisory Board

Sl. No.	Members
1	Dr. U.V Babu, Head- Phytochemistry, Research and Development, Himalaya Drug Company, Yeshwantpur, Bangalore.
2	Dr. Subramanya, Department of Life Sciences, Foundations for Revitalisation of Local Health Traditions (FRLHT), Yelahanka, Bangalore
3	Dr.Sudha Devaraj Director, Aristogene Biosciences PVT. Ltd. Rajaji Nagar Industrial Estate,Bangalore.
4	Dr. V.R. Devaraj, Professor, Department of Biochemistry,Bangalore University
5	Dr. Renuka Srihari, Professor, Department of Biochemistry, MLACW, Bangalore

CBCS (CHOICE BASED CREDIT SYSTEM) AND CAGP (CONTINUOUS ASSESSMENT AND GRADING PATTERN) OF EDUCATION AND ITS ADVANTAGES

CBCS is a proven, advanced mode of learning in higher education. It facilitates students to have freedom in making their own choices for acquiring a Masters Degree program. It is more focused towards the student's choice in providing a wide range of modules available in a single campus across various disciplines offered by experts in the subjects. It leads to quality education with active teacher-student participation.

Studying under CBCS has following advantages:

- Students may undergo training in cross-disciplinary and multi-disciplinary subjects and acquire more focused and preferred knowledge.
- Students are allowed to practice various methods of learning a subject.
- Students may get more skills from other subject(s) which are required for the career path in addition to their regular subject knowledge.
- Students may get ample opportunities to use the laboratories and gain practical exposure to the much needed modules available in other departments/schools for want of scientific inputs.
- Courses are conducted by subject experts identified on the basis of their experiences. Courses taught by such experts may provide in-depth information and clear understanding of the modules.
- Students may get an opportunity to study courses with other students of different programs and exchange their views and knowledge in a common class room.
- CBCS provides a cross-cultural learning environment.
- Students may benefit much from selecting the right options to successfully placed in the industries having production / Research and Development divisions. Also to compete in public service examinations like CSIR-UGC JRF/NET, GATE, UPSC and other Central Institute recruitment services wherein the knowledge of additional subjects become mandatory for general or optional papers.

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Two Years Post Graduate Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practical where:

L stands for **Lecture** session consisting of classroom instruction.

T stands for **Tutorial** session consisting participatory discussion / self-study/ desk work/ brief seminar presentations by students and such other novel methods that make a student to absorb and assimilate more effectively the contents delivered in the Lecture classes.

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies that equip students to acquire the much required skill component.

2.0 Course of Study and Credits:

The Program is grouped under various courses. Each of these courses carries credits which are based on the number of hours of teaching and learning. In terms of credits every one-hour session of L amounts to 1 credit per Semester and a minimum of 2 hour session of T or P amounts to 1 credit per semester or a three hour session of T/P amounts to 2 credits over a period of one semester of 16 weeks for teaching-learning process.

The total duration of a semester is 20 weeks inclusive of end-semester examination.

A course shall have only lecture, lecture and tutorial or practical component or combination of any two or all the three components.

The total credit earned by a student at the end of the semester upon successfully completing the course are L + T + P. **The credit pattern of the course is indicated as L:T:P.**

2.1. Various course of study are labelled and defined as: (i) Core Course (CC) (ii) Hard Core Course(HC)(iii)Soft Core Course(SC) (iv) Open Elective Course (OE).

(i) **Core Course (CC):** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Hard Core Course (HC):** The **Hard Core Course** is a Core Course in the main branch of study and related branch (es) of study, if any that the candidates have to complete compulsorily.

(iii) **Soft Core Course (SC):** A Core course may be a **Soft Core** if there is a choice or an option for the candidate to choose a course from a pool of courses from the main branch of study or from a sister/related branch of study which supports the main branch of study.

(iv) O**pen Elective Course (OE):**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an O**pen Elective Course.**

2.2. Project Work: Project work is a special course involving application of knowledge in solving / analyzing /exploring a real-life situation / difficult problem.

School of biochemistry, REVA University is associated with several central govt research organizations namely CIMAP, FRLHT, CIFT, CFTRI, and other research organizations like

Himalaya Drugs, Clinical research institutes [Clini India], SKANDA Labs, Clinical Diagnostics Labs, [ELIBT Laboratories, CHANRe Diagnostics] for students projects.

2.3. Minor Project:

A minor project work along with practical sessions as a hard core.

2.4. Major Project / Dissertation:

The Major Project / Dissertation shall be Hard Core.

The Project work and presentation commence soon after the completion of the second semester end examination. This project work is preliminary and will continue during fourth semester. A project work of Four and Fourteen credits together with eighteen is called Major Project work.

3.0. Total Credits to be earned:

3.1. A candidate has totally 96 credits for entire MSc Biochemistry program with a distribution of credits are tabulated in the next section for different courses as prescribed by the university as illustrated in scheme of instruction.

3.2. The credit system vary for different courses and a candidate can enrol for a maximum ranges of 22 to 25 per Semester.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free-ship, and such otherrewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add on Proficiency Diploma and Add on Proficiency Certification:

4.1. Add on Proficiency Diploma: In excess to the minimum of 96 credits prescribed a candidate can opt to complete a minimum of 18 extra credits to acquire add on proficiency diploma in a particular discipline / subject in his / her subject of study or in other subjects / discipline along with the masters' degree.

4.2. Add on Proficiency Certification: To acquire add on proficiency certification a candidate can opt to earn a minimum of 4 extra credits either in the field of Biochemistry or in different discipline(s) / subject(s) in addition to a minimum of 96 prescribed credits for the Masters degree program.

5. Scheme of Assessment & Evaluation for P G Degree Programs of two years duration

5.1. The Scheme of Assessment and Evaluation will have two components, namely;

i. Internal Assessment (IA); and ii. Semester End Examination (SEE)

5.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of PG programs shall carry 50 marks each (i.e., 50 marks internal assessment; 50 marks semester end examination).

5.3. The 50 marks of Internal Assessment (IA) shall comprise of:

Internal Test (2) = 30 marks

Assignments (2) = 10 marks

Seminars (2) = 10 marks

5.4. There shall be three internal tests conducted as per the schedule given below. The students have to attend all the three tests compulsorily.

- 1st test for 15 marks at the end of 5th week of the beginning of the Semester;
- 2nd test for 15 marks at the end of the 10th week of the beginning of the Semester; and
- 3rd test for 15 marks at the end of the 15th week of the beginning of the Semester

5.5. The coverage of syllabus for the said three tests shall be as under:

- For the 1st test syllabus shall be 1st unit and 1st half of Second Unit of the Course;
- For the 2nd test it shall be 2nd half of Second Unit and Third Unit of the Course;
- For the 3rd test the syllabus will be 4th Unit of the Course.

5.6. Out of 3 tests, the highest marks scored in two tests / average are automatically considered while assessing the performance of the students along with the attendance for the complete semester.

5.7. There shall be two Assignments and two Seminars each carrying 5 marks each. Hence two assignments carry 10 marks (5+5 marks) and two seminars carry 10 marks (5+5 marks) as stated above.

5.8. The duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.

5.9. The Semester End Examination (SEE) for 50 marks shall be held during 19th and 20th week of the beginning of the semester and the syllabus for the semester end examination shall be entire 4 units.

5.10. There shall be double evaluation, viz, first valuation by the internal teachers who have taught the subject and second evaluation shall be the external examiner.

5.11. The average of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results. However the difference between the marks awarded by the external and internal examiners shall not be more than 20%.

In such cases where there is a difference of more than 20%, there shall be third valuation by the external examiner who has not valued the script, in which case the average of the marks awarded by the third valuer and nearest marks of the marks awarded by the first two examiners (internal and external) shall be considered for declaration of results.

5.12. Summary of Internal Assessment and Evaluation Schedule is provided in the table given below:

Summary of Continuous Assessment and Evaluation Schedule

Type of Assessment	**Period**	**Syllabus**	**Marks**	**Activity**
Allocation of Topics for Assignments / Seminars / Model making	Beginning of 5th Week	First Unit and Second Unit		Instructional process and Continuous Assessment
First Internal Test	Second Part of 6th Week	First Unit and 1st half of Second Unit	15	Consolidation of First Unit and 1st half of Second Unit
Submission of Assignments	8th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Seminars	9th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2nd Part of 13th Week	2nd half of Second Unit and Third Unit	15	Consolidation of 2nd half of Second Unit and Third Unit
Allocation of Topic for 2nd Assignment / Seminars	11th Week	Third Unit and Fourth Unit		Instructional process and Continuous Assessment
Submission of Assignments	13th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Seminars	14th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Third Internal Test	2nd Part of 16th Week	Fourth Unit	15	Consolidation of Entire Fourth Unit

Semester End Practical Examination	17th & 18th Week	Entire Syllabus	50	Conduct of Semester- end Practical Exams
Preparation	17th & 18th	Entire		Revision and
for Semester–End Exam	Week	Syllabus		preparation for semester–end exam
Semester End Theory Examination	19th and 20th Week	Entire Syllabus	50	Evaluation and Tabulation
	End of 21st Week			Notification of Final Grades

Note:

1. *As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and confusion.

2. Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.

3. Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.

6. Assessment of Performance in Practical's

6.1. The performance in the practice tasks / experiments shall be assessed on the basis of: a) Knowledge of relevant processes b) Skills and operations involved c) Results / products including calculation and reporting with error calculation.

6.2. The 50 marks meant for continuous assessment of the performance in carrying out practical shall further be allocated as under:

I	Conduction of regular practical / experiments throughout the semester	20 marks
II	Maintenance of lab records	10 marks
III	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment	20 marks
	Total	**50 marks**

6.3. The 50 marks meant for Semester End Practical Examination, shall be allocated as under:

I	Conduction of semester end practical examination	30 marks
II	Write up about the experiment / practical conducted	10 marks
III	Viva Voce	10 marks
	Total	**50 marks**

6.4. The duration for semester-end practical examination shall be decided by the concerned School Board.

7. Evaluation of Minor Project / Major Project / Dissertation: Right from the initial stage of defining the problem, the candidate has to submit the progress reports periodically and also present his/her progress in the form of seminars in addition to the regular discussion with the supervisor. At the end of the semester, the candidate has to submit final report of the project / dissertation, as the case may be, for final evaluation.

The components of evaluation are as follows:

I	Periodic Progress and Progress Reports (25%)
II	Results of Work and Draft Report (25%)
III	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

8. Provision for Appeal

If a candidate is not satisfied with the evaluation of Internal Assessment components, he/she can approach the grievance cell with the written submission together with all facts, the assignments, test papers etc, which were evaluated. He/she can do so before the commencement of semester-end examination. The grievance cell is empowered to revise the marks if the case is genuine and is also empowered to levy penalty as prescribed by the university on the candidate if his/her submission is found to be baseless and unduly motivated. This cell may recommend taking disciplinary/corrective action on an evaluator if he/she is found guilty. The decision taken by the grievance cellis final.

Grievance Cell:

For every program there will be one grievance cell. The composition of the grievance cell is as follows. The Registrar (Evaluation) - Ex-officio Chairman / Convener One Senior Faculty Member (other than those concerned with the evaluation of the course concerned) drawn from the school / department/discipline and/or from the sister schools / departments/sister disciplines – Member. One Senior Faculty Members / Subject Experts drawn from outside the University school / department – Member.

9. Eligibility to Appear for Semester End Examination (SEE)

Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the program, as provided in the succeeding sections, shall be eligible to appear for Semester End examination.

10. Requirements to Pass the Semester and to Carry Forward the Failed Subjects / Courses:

10.1. Requirements to Pass a Course

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 + SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 30% (15 marks) in Semester End Examination (SEE) which is compulsory.

10.2. Provision to carry forward the failed subjects / courses:

The student who has failed in 4 courses in odd and even semesters together shall move to next semester of immediate succeeding year of study. And he / she shall appear for SEE of failed courses of previous semesters concurrently with even end SEE of current year of study. However, he / she shall have to clear all courses of both odd and even semesters of preceding year to register for next succeeding semester. Students of final semester program can appear for make up examinations.

11.0. Re-Registration and Re-Admission:

11.1. In case a candidate fails in more than 4 courses in odd and even semesters together in a given academic year has to seek re-admission to those semesters during subsequent year within a stipulated period.

11.2. In case a candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University, such a candidate is not allowed to appear for end semester examination (SEE) and he / she shall have to seek re-admissionto that semester during subsequent year within a stipulated period.

11.3. In such case a candidate drops all the courses in semester due to personal reasons he / she readmission to such dropped semester.

12.0. Attendance Requirement: a) All students must attend every lecture, tutorial and practical classes. b) In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes attended. c) Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the SEE. d) Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of SEE, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of SEE. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

12.1. Absence during Internal test: In case a student has been absent from a internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for conducting a separate internal test. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester end examination of that respective semester. Under no circumstances internaltests shall be held / assignments are accepted after Semester end examination.

12.2. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

13.0. Provisional Grade Card: The tentative / provisional grade card shall be issued by the Registrar (Evaluation) at the end of every semester indicating the courses completed successfully. The provisional grade card provides Semester Grade Point Average (SGPA). The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student,
i. e SGPA (Si) = ∑(Ci x Gi) / ∑Ci Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

13.1. Final Grade Card: Upon successful completion of MSc in Biotechnology Degree a Final Grade card consisting of Grades of all courses successfully completed by the candidate will be issued by the Registrar (Evaluation).

13.2. The Grade and the Grade Point: The Grade and the Grade Point earned by the candidate in the subject will be as given below.

Marks P	**Grade G**	**Grade Point (GP=V x G)**	**Letter Grade**
90-100	10	v*10	O
80-89	9	v*9	A
70-79	8	v*8	B
60-69	7	v*7	C
50-59	6	v*6	D
40-49	5	V*5	E
0-39	0	v*0	F

O - Outstanding; A-Excellent; B-Very Good; C-Average ; C+-Average; C-Satisfactory; F – Unsatisfactory.

Here, P is the percentage of marks (P=[(IA)+SEE] secured by a candidate in a course which is rounded to nearest integer. V is the credit value of course. G is the grade and GP is the grade point.

13.3. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for MSc BT degree is calculated taking into account all the courses undergone by a student over all semesters of a program, i.e: CGPA = ∑(Ci x Si) / ∑Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

13.4. Computation of SGPA and CGPA

The Following procedure to compute the Semester Grade Point Average (SGPA)

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e 24

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A	9	4X9=36
Course 2	4	B	8	4X8=32
Course 3	3	C	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	E	5	3X5=15
Course 6	3	D	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	B	8	2X8=16
	24			188

Thus, SGPA = 188 ÷ 24 = 7.83

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	B	8	4X8=32

Course 2	4	C	7	4X7=28
Course 3	3	A	9	3X9=27
Course 4	3	C	7	3X7=21
Course 5	3	D	6	3X6=18
Course 6	3	E	5	3X5=15
Course 7	2	C	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	D	10	4 x 10 = 40
Course 2	4	A	9	4 x 9 = 36
Course 3	3	C	7	3 x 7 = 21
Course 4	3	D	6	3 x 6 = 18
Course 5	3	A	9	3 x 9 = 27
Course 6	3	C	7	3 x 7 = 21
Course 7	2	A	9	2 x 9 = 18
Course 8	2	A	9	2 x 9 = 18
	25			199

Thus**, SGPA = 199 ÷ 25 = 8.29**

9.5. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (144) for MSc Biochemistry program is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci

Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	6.83	24 x 6.83 = 163.92
2	24	7.29	24 x 7.29 = 174.96

3	24	8.29	24 x 8.29 = 198.96
4	24	8.55	24 x 8.55 = 205.20
Cumulative	96		743.04

Thus, CGPA = $\frac{24x6.83+24x7.29+24x8.29+24x8.55}{96}$ = 7.74

CONVERSION OF GRADES INTO PERCENTAGE: Conversion formula for the conversion of CGPA into Percentage is: Percentage of marks scored = CGPA Earned x 10
Illustration: CGPA Earned 7.67 x 10 = 76.7

14. Classification of Results

The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

CGPA	**FGP**	
	Numerical Index	**Qualitative Index**
> 4 CGPA < 5	**5**	SECOND CLASS
5 > = CGPA < 6	6	
6 >= CGPA < 7	7	FIRST CLASS
7 >= CGPA < 8	8	
8 >= CGPA < 9	9	DISTINCTION
9 >= CGPA 10	10	

Overall percentage=10*CGPA

15. Challenge Valuation

A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 07days after the announcement of the results. This challenge valuation is only for SEE.
The answer scripts for which challenge valuation sought for shall be evaluated by the external examiner who has not involved in the first evaluation. The higher of two marks from first valuation and challenge valuation shall be the final.

16. With regard to any specific case of ambiguity and unsolved problem, the decision of the Vice Chancellor shall be final.

M Sc in BIOCHEMISTRY (2017-18 batch)

Eligibility: Bachelors Degree of three years with Biochemistry,Chemistry or any Life Science subject as one of the cognate / major / optional subjects with 45% (40% in case of candidates belonging to SC/ST) of marks in aggregate from any recognized University / Institution or any other qualification recognized as equivalent thereto.

Table

Course Structure and Credit Distribution across Semesters

* Hard-Core Course- includes practical lessons

**Soft-Core Course- does not include practical lessons

+Open Elective

M Sc (Biochemistry) Program Overview

Biochemistry explores the chemical processes within and related to living organisms. The subject focuses on processes happening at a molecular level. It focuses on what's happening inside our cells by studying components like proteins, lipids and organelles. It also looks at how cells communicate with each other, for example during growth or fighting illness. Biochemists need to understand how the structure of a molecule relates to its function, allowing them to predict how molecules will interact.

By using chemical knowledge and techniques, biochemists can understand and solve biological problems

Biochemistry covers a range of scientific disciplines, including genetics, microbiology, forensics, plant science and medicine. Because of its breadth, biochemistry is very important and advances in this field of science over the past 100 years have been staggering. It's a very exciting time to be part of this fascinating area of study.

Biochemists find opportunities in Hospitals, Universities, Agriculture, Food institutes/organisations, Cosmetics, Forensic crime research, Drug discovery and development, and many other sectors.

In India, the hospital, pharmaceutical, food processing and agricultural sectors are all growing at a significant rate and development of biotech industries is being given prime importance by the Government of India to make it $100 billion industry by 2025, creating greater opportunities for Biochemists.

In this context, University Programme in Biochemistry at postgraduate level in India remains relevant for the creation of trained human resources.

M. Sc. (Biochemistry) at REVA UNIVERSITY has been designed to meet the human resources needs of existing and futuristic biotech industries and biotech research organizations involved in pharmaceuticals, food processing, agriculture, biomedical devices development; academic institutions and hospitals. The programme is designed to produce graduates with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently to meet higher level expectations of biotech industries, research organizations, hospitals and academic institutions. The programme in addition to core courses covers a number of specialized electives in the areas of Bioinformatics, Food Technology, Pharmacovigilance and SAS, Clinical Biochemistry and Diagnostics, and Plant & Industrial Biochemistry. The short term training in industries / R & D institutions, Internships, Student Projects in Biochemistry, Clinical Research, SAS and Clinical Diagnostics provide opportunity for the students to choose and acquire in-depth knowledge and skills in their area of interest.

Programme Educational Objectives (PEOs)

PEO-1	Become a professional biochemist with strong ethics and communication skill
PEO-2	Pursue carrier in reputed industry and diagnostic laboratories
PEO-3	Explore idea in research and consultancy services to develop new process and product

Programme Outcomes (POs)

PO-1: Science knowledge: Apply the knowledge of different fundamentals of life sciences including healthcare considering public health and safety, and the cultural, societal, and environmental concerns.

PO-2: Problem analysis: Identify, design and analyse problems related to the various domains of Biochemistry such as Clinical Biochemistry, Agricultural Biochemistry, Genetic Engineering, Molecular Biology, Food biochemistry and enzymatic diagnosis.

PO-3: Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-4: Modern tool usage: Identify, select the methodology, and apply appropriate techniques, resources, and modern technology for product/process development which in turn benefit the society.

PO-5 Environment and sustainability: Understand and implement environmental-friendly approaches in Biochemistry to support sustainable development.

PO-6: **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms in life sciences.

PO-7: **Individual and team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO-8: Communication: Communicate effectively with the science community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

PO-9: Project management and finance: Prove knowledge and understanding of Biochemistry and management principles and apply these to research work, as a member and leader in a team. Manage projects in interdisciplinary field.

PO-10: Life-long learning: Recognize the need for, and have the preparation as well as abilityto engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

After successful completion of the programme, the graduates shall be able to

PSO-1: Work as scientist or biochemist experts in industries and research organizations in ateam with further training.

PSO-2: Develop strong ethics and communication as consultant with lifelong learningattitude.

PSO-3: Use higher order critical, analytical skill to solve a new problem.

REVA UNIVERSITY
M.Sc. BIOCHEMISTRY

Scheme of Teaching, Examination and Credits

FIRST SEMESTER MSc Biochemistry

Scheme & Syllabus-2017

Course code I Semester	Title of the paper	Type of paper	Periods / Weeks	Duration of Exam Hours	IA	EA	Maximum Marks	Credit
MSBC16F1100	Fundamentals of chemistry and Toxicology	H Core	4	3	50	50	100	4
MSBC16F1200	General Physiology	H Core	4	3	50	50	100	4
MSBC16F13 00	Bioenergetics and Intermediary Metabolism	H Core	4	3	50	50	100	4
MSBC16F1400	Analytical Techniques	H Core	4	3	50	50	100	4
MSBC16F1500	Biomolecules	S Core	2	1 1/2	25	25	50	2
MSBC16F1600	Laboratory Course I and Short term Training	Practical	12	6	20(practical) 30(project)	50	100	6
	Total Marks and Credits						500	20

Second Semester

Sl. No	Code	Title	HC/ SC/ FC	Credit Pattern			Credits
				L	T	P	

1	MS17BC301	Molecular Biology	HC	3	1	0	4
2	MS17BC302	Nutritional Biochemistry	HC	3	1	0	4
3	MS17BC303	Research Methodology & Statistics	HC	3	1	0	4
4	MS17BC304	Biochemistry in daily life *	OE	2	1	0	4
5	MS17BC305	Laboratory cum Training - V (Advanced Molecular Techniques)	HC	2	0	4	4
6	MS17BC306	Project work and presentation **	HC		0	4	4
Total Credits				**13**	**4**	8	**24**

Third Semester

Sl. No	Code	Title	HC/ SC/ FC	Credit Pattern			Credits
				L	T	P	
1	MS17BC201	Enzymology	HC	3	1	0	4
2	MS17BC202	Biotechnology	HC	3	1	0	4
3	MS17BC203	Immunology	HC	3	1	0	4
4	MS17BC204	Biochemical genetics	HC	2	1	0	3
5	MS17BC215	Bioinformatics	SC	2	0	0	2
6	MS17BC225	Food Technology	SC				
7	MS17BC206	Laboratory cum Training – III (Protein chemistry and Immunology)	HC	0	0	4	4
	MS17BC207	Laboratory cum Training - IV(Molecular Biology and Bioinformatics)	HC	0	0	4	4
Total Credits				**13**	**4**	8	**25**

*OE = Open Elective course “Biochemistry in daily life” is offered for students belonging to other schools. The students of M Sc Biochemistry have to choose Open Elective offered by other schools.
** The Project work and presentation commence soon after the completion of the second semester end examination. This project work is preliminary and will continue during fourth semester.

Fourth Semester

Sl. No	Code	Title	HC/ SC/ FC	Credit Pattern			Credits
				L	T	P	
1	MS17BC411	Pharmacovigilance and SAS	SC	3	1	0	4

2	MS17BC421	Clinical Biochemistry and Diagnostics	SC				
3	MS17BC431	Plant and Industrial Biochemistry	SC				
4	MS17BC402	Laboratory cum Training - VI (Genetic Engineering)	HC	0	0	4	4
5	MS17BC403	Project work-dissertation (continued from III Semester)	Project report	-	-	14	14
Total Credits							**22**
Total Credits of all Semesters							**96**

Project Guidelines

1. Students should develop a project individually.

2. They should implement their project in the university/Government or Private laboratory after approval of the Head of School.

3. The project should be subject based. The students have to collect data outside practical hours.

4. Internal marks can be awarded by the guide by evaluating the performance of The students during the course of project work.

6. In viva-voce the questions must be directed only on the project work to access The involvement and understanding of the problem by the students.

7. The project carries 200 marks is distributed as follows:

Demonstration and Presentation	130 Marks
Viva-voce	50 Marks
Project Report	20 Marks

Training and Placement

A degree with real life skills will open doors to the world of opportunities. But Employers are looking for much more than just a degree.

Popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills

8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

The REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counselling, Training and Placement (CCTP) Centre headed by well experienced dynamic Trainer, Counsellor and Placement Officer supported by an efficient team does handle all aspects of Internships and Placement for the students of REVA University. The prime objective of the CCTP Centre is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CCTP Centre organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CCTP Centre forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality. The University has signed MOU's with Multi-National Companies, research institutions and universities abroad to facilitate greater opportunities of employability and as well students' exchange programs for higher learning.

The need of the hour is efficient leaders of repute, who can deal the real time problems with a pinch of innovation. This kept in focus, the training and Placement cell has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, strategic management and communication skills to every student of REVA University are given with utmost care. The process involves continuous training and monitoring the students to develop their interpersonal skills that will fetch them a job of repute and to choose a proper career path.

FACULTY PROFILE - SCHOOL OF BIOCHEMISTRY

MRS. JAYASHREE.S
Professor and Head School of Biochemistry, REVA University
Specialization: General Biochemistry

Dr.V.VEERA RAGHAVAN
Professor, School of Biochemistry, REVA University
Specialization: Clinical Biochemistry

MR.CHARAN RAJ T P
Assistant Professor, School of Biochemistry, REVA University
Specialization: Organic Chemistry

MRS.JAYASRI.P
Assistant Professor, School of Biochemistry, REVA University
Specialization: Analytical techniques

MRS.DEEPA.H N
Assistant Professor, School of Biochemistry, REVA University
Specialization: Enzymology

MS.MEGHANA. M.V
Assistant Professor, School of Biochemistry, REVA University
Specialization: General Physiology

MS.SMITHA.A R
Lab Instructor, School of Biochemistry, REVA University

FIRST SEMESTER CALENDAR 2017-18 (REVA)

Time Table for First Semester **W.E.F**

	8.30-9.30	9.30-10.30		10.45-11.45	11.45-12.45		1.30-2.30	2.30-.30	3.30-4.30
Mon			TEA BREAK			LUNCH BREAK			
Tue									
Wed									
Thu									
Fri									
Sat									

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university.
2. Be regular and punctual to classes.
3. Study regularly and submit assignments on time.
4. Be respectful to you Teachers/friends and hostel staff / management.
5. Read the notice board (both at your college and the hostel) regularly.
6. Utilize your Personal Computer for educational purpose only.
7. Follow the code of conduct.
8. Visit Health Centre on the campus whenever you are unwell.
9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
10. Carry your valuables along with you whenever you proceed on leave/vacation.
11. Use electric appliances, lights and water optimally.
12. Keep the campus clean and hygienic.
13. Use decent dressing.

DONT'S

1. Ragging inside/outside the campus.
2. Use of Alcohols, Toxic drugs, sheesha, gutka and hashish/heroin etc.
3. Use of Crackers, explosives and ammunition etc.
4. Smoking and keeping any kind of such items.
5. Misusing college & hostel premises/facilities for activities other than studies.
6. Playing loud music in the room which may disturb studies of colleagues/neighbours.
7. Making noise and raising slogans.
8. Keeping electrical appliances, other than authorised ones.
9. Involvement in politics, ethnic, sectarian and other undesirable activities.
10. Use of mobiles in academic areas.

I SEMESTERPAPER-I

MS17BC101: Organic, Biophysical, Biochemical and Environmental Toxicology

52hrs

Unit-1

ORGANIC CHEMISTRY

Electronic theory of valency. Electronic displacements in a molecule: Inductive effect, Electronic effect, resonance. The hydrogen bond, hydrophobic interactions. Atomic and molecular orbitals. Shapes of biomolecules, hybridization and tetracovalency of carbon.

Types of organic reactions: Substitution, addition, elimination, rearrangement, condensation and polymerization.

Free radicals in biological system: Oxygen as free radical in the auto oxidation of fats. Antioxidants (free radicals inhibitors in the cell such as vitamin A, vitamin E,vitamin C,Se etc)

Mechanism of substitution in benzene ring: ortho, para and Meta directing groups. The concept of resonance with reference to benzene derivatives. Direct influence of substituents- Electronic interpretation. **13hrs**

Unit-2

Stereochemistry: Structural isomerism, stereoisomerism, geometrical isomerism. Opticalisomerism,opticalactivity,mesocompounds,specificrotation,chirality,chiralcentre enantiomers,diastereoisomeres,confirmation and configuration, boat and chair forms, axialandequatorialbonds,anomersandmutarotation,glycoside,epimers,glucopyranose, fructopyranose, periodic acid oxidation of sugars.

Heterocyclic systems occurring in living systems: Numbering of the ring and properties of pyran, furan, thiazole, indole, pyridine, pyrimidine quinine,purine and pteridine. **13hrs**

Unit-3

Biophysical chemistry

Thermodynamics studies in chemistry and biochemistry: Definition and application of the first and second law of thermodynamics in understanding energies in living cells, chemical potential, equilibrium constant. Phosphate group transfer potentials.

Biological solvents: Water properties, dipole moments, ionic product of water

Acids, Bases and Buffers: pH scale, acids-bases, Henderson-Hasselbalch equation, buffers, ionization behavior of amino acids and proteins, titration curve, buffer solutions and action.

Microbiology: Physical,environmental and nutritional requirements for growth(growth curve).continuos culture of bacteria and synchronous growth of bacteria.Preparationof culture media, staining techniques and isolation of pure cultures. starter cultures for dairy industry. Fermented products. (food and dairy)
11hrs

Unit-4

BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY **15hrs**

Definition and scope of toxicology: Eco-toxicology and its environmental significance. Toxic effects: Basic for general classification & nature. Dose - Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Factors influencing Toxicity. Pharmacodynamics & Chemodynamics.OECD guidelines.

Principles & procedures of testing for acute toxic effects: Regulatory guidelines, Mammalian systems affected & the clinical signs of Systemic Toxicity. Factors affecting acute Toxicity studies.

Xenobiotic metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reactions/Conjugation: Methylation, Glutathione and amino acid conjugations.

Biochemical basis of toxicity: Mechanisms of Toxcity: Disturbance of Excitable membrane functions. Altered calcium Homeostasis. Covalent binding to cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity.

Pesticidetoxicity: Insecticides: Organochlorines, Anticholinesterases. Organophosphates and Carbamates. Fungicides.Herbicides. Environmental consequences of pesticide toxicity. Biopesticides.

Food toxicity: Common food adultrants, detection of adultrants, sources and effects of food toxicants. Toxicology of food additives i.e preservatives, colourants taste enhancers

Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium, sources and permissible limits of metals in organs, antidotes.

PAPER-II

MS17BC102: GENERAL PHYSIOLOGY

52hrs

Unit-1:

Muscular System: Ultra structure of smooth, skeletal and cardiac muscle fibers. Contractile and other proteins of muscle. Energy metabolism in muscle; Phosphagens, neuro-muscular junctions, excitation of striated muscles. Organization of sarcolemma, transverse-tubular system and sarcoplasmic reticulum, mechanism of muscle contraction. Regulation of contraction in striated and smooth muscle. Calmodulin and its regulatory role, muscular dystrophies.

Resting potentials and action potentials of excitable cells, contraction of skeletal,cardiac and smooth muscles

Cardiovascular system: Anatomy and physiology of blood vessels, structure of heart, cardiac cycle, heart sounds, ECG, blood pressure and haemorrhage. **13hrs**

Unit-2

Nervous system: Types and structure of neuron. Neurotransmitters and receptors, mechanism of synaptic transmission. Briefly about membrane potential, resting potential and action potential. Briefly about EEG and epilepsy. Outline and function of CNS and PNS.Neuromuscular junctions. **7hrs**

Biochemistry of cancer – carcinogenesis, characteristics of cancer cell, agentspromoting carcinogenesis. **2hrs**

Respiratory system: Anatomy of lungs, mechanism and regulation of respiration, transport of gases O_2 and CO_2 respiratory, mechanism of acid and base balance with briefly the disorders of respiratory system. **4hrs**

Unit-3:

Blood and Body fluids: Composition and functions of blood. Erythrocytes including Hb, leukocytes and thromobocytes plasma proteins in health and diseases. Blood coagulation – mechanism and regulation. Fibrinolysis,anticoagulants,transfers of blood gases – oxygen and carbon dioxide. Hydrogen ion homeostasis- Factors regulating blood pH – buffers. Composition and functions of lymph and CSFAcid-base balance, metabolic and respiratory acidosis and alkalosis. **7hrs**

Digestive system:– Secretions, functions and regulation of saliva, gastric, pancreatic, intestinal and bile juice.

Digestion and absorption of carbohydrates, lipids, proteins, nucleic acids, minerals and vitamins. **6hrs**

Unit-4

Renal physiology and Excretion: Structure and functional unit of kidney, mechanism of urine formation (Glomerular filtration, Tubular reabsorption and Tubular secretion), concentration of urine, tubular function test, kidney hormones, regulation of acid-base balance, electrolyte and water balance. Renal failure, nephrosisand nephrites **7hrs**

Endocrine system: Chemistry of hormones and hormonal activity**.** Site of synthesis , secretion,functions and Circulation in blood of hypothalamus, pituitary, thyroid, adrenal cortex, parathyroid and pancreas, local hormones and their biological significance.Degradation and peripheral transformation.Receptors and the mechanismof hormone action.Disorders of endocrine system. **6hrs**

PAPER-III

MS17BC103: BIOENERGETICS AND INTERMEDIARY METABOLISM

52hrs

Unit-1

Bioenergetics: Energy transformation, Laws of thermodynamics, Biological oxidations, oxygenases, hydroxylases, dehydrogenases and energy transducing membranes. Gibbs energy, free energy changes and redox potentials, phosphate potential,chemo-osmotic theory.Proton circuit and electrochemical gradient, ionophores. Uniport, antiport and symport mechanisms, shuttle systems.

The mitochondrial respiratory chain, order and organization of carriers, proton gradient, iron sulphur proteins, cytochromes and their characterization. The Q cycle; P/O ratio. Reversed electron transfer, respiratory controls and oxidative phosporylation, uncouplers and inhibitors of energy transfer. Fractionation and reconstitution of respiratory chain complexes.
ATP – synthetase complex., partial reduction of oxygen, superoxides.
12hrs

Unit-2

Intermediary metabolism: Approaches for studying metabolism. Introduction to metabolism.

Carbohydrates: Glycolysis, citric acid cycles, its function in energy generation and biosynthesis of energy rich bonds, pentose phosphate pathway and its regulation. Alternate pathways (glyoxalic and uronic acid pathways)of carbohydrate metabolism. 38

Gluconeogensis. Interconversions of sugars. Biosynthesis of glycogen, starch and oligosaccharides.
Regulation of blood glucose homeostasis. Hormonal regulation of carbohydrate metabolism.

12hrs

Unit-3: Lipids

Fatty acid biosynthesis: Acetyl CoA carboxylase, Fatty acid synthase, desaturase and elongase. Fatty acid oxidation: α, β, ω oxidation and lipoxidation. Lipid Biosynthesis: Biosynthesis of triacyglycerols, phosphoglycerides and sphingolipids, Biosynthetic pathways for terpenes, steroids and prostaglandins. Ketone bodies: Formation and utilization. Metabolism of circulating lipids: chylomicrons, LDL, HDL and VLDL. Free fatty acids. Lipid levels in pathological conditions.

Amino Acid Metabolism : Overall nitrogen metabolism,digestion of dietary proteins,transaminationreaction(ALT,AST),mechanism of action of aminotransferases.Urea cycle and its regulation.Metabolism of ammonia and its disorders.Biosynthesis and degradation of essential and non essential amino acids and their regulation.Synthesis and degradation of catecholamines.In-born errors of amino acid metabolism.

17hrs

Unit-4
Nucleic Acid Metabolism: Biosynthesis of purines and pyrimidines. Degradation of purines and pyrimidines. Regulation of purine and pyrimidines biosynthesis. Structure and regulation of ribonucleotide reductase.Biosynthesis of ribonucleotides, deoxy ribonucleotides and polynucleotides. Inhibitors of nucleic acid biosynthesis.Salvage pathways.Disorders of nucleic acid metabolism.

11hrs

PAPER-IV

MS17BC104: ANALYTICAL TECHNIQUES

52 hrs

Unit-1

Centrifugation: Basic principles of centrifugation.Factors affecting sedimentation, Sedimentation Coefficient, Instrumentation and applications of Desktop, High speed and Ultra centrifuges; Preparative and Analytical centrifugation; Density gradiant and differential centrifugation and Isopycnic Centrifugation,

Extraction methods for preparation of samples: Preparation of extracts for biochemical investigations, physicochemical properties of metabolites and drugs

extracts from biological materials. Physico-chemical properties of solvents, solubility and missibility, ionic bonds, and salting out. Partition, ionization, buffering and their effect on extraction. Choice of solvent for solvent extraction, mixed solvents, solid phase extraction.

13hrs

Unit-2

Chromatography: Introduction, partition coefficient, phase systems- liquid and solid phases. Principle, instrumentation and applications of paper and thin layer chromatography.column chromatography-Ion exchange, Affinity and gel permeation Chromatography, HPLC.

Gas chromatography: Principle and design of instrument. Factors affecting GC, .Types of detectors (flame ionization , thermionic , electron capture , mass spectrometer).G.L.C; principle and application. **13 hrs**

Unit-3

Electrophoresis: Basic principles of electrophoresis and factors effecting electrophoretic mobility, Agarose gel electrophoresis of nucleic acids, capillary and pulse field,capillary electrophoresis.SDS PAGE.

Electro blotting: Western, southern, northern equipments and application. GIMSA assay.

Microscopic techniques: Types of microscopy(light, Phase Contrast ,florescence,dark field.Electron Microscopy- Working principle and applications of TEM and SEM, advantages.Immune gold , cryo-electron and Trans focal microscopy.

13hrs

Unit-4

Spectroscopic techniques: Electromagnetic spectrum, transition in spectroscopy. Principle, design and application of UV-Visible , fluorescence,

IR ,Raman IR , Atomic Absorption Spectroscopy,Flame photometer.

Principle, instrumentation and applications of X-RAY crystallography,NMR,ESR,

Mass Spectroscopy: Principle, overview of MS experiment, ionization modes: MALDI, equipments in MS analysis (Identification of metabolites). Interfacing MS with other methods; MS/MS, LC/MS, GC/MS.

13 hrs

PAPER-V MS17BC105:BIOMOLECULES

26Hrs

Unit 1: Carbohydrates and lipids

Carbohydrates: Structure, Classification and function of carbohydrates. Structure characteristics and biological importance of aminosugars , glycosides, bacterial polysaccharides, glycoproteins, blood group antigens and Lectins

Lipids Structure, Classification ,Characteristics and biological importance of lipids. Behavior of amphipathic lipids in water, formation of micelles and lioposomes. Prostaglandins.Bio membranes, membrane composition and fluid mosaic model.

13Hrs

Unit 2: PROTEINS AND NUCLEIC ACIDS

Proteins: Structure, Classification and properties of amino acids and proteins. Structural organization of proteins- Keratin, silk fibroin, collagen , myoglobin, haemoglobin, Integral membrane proteins,,concanavalin-A and Rossmann fold, ribonuclease, glyceraldehyde-3-phosphate dehydrogenase, lysozyme, chymotrypsin ,Triose phosphate isomerase . **13hrs**

MS17BC106 : Laboratory cum Training- I (BioPhysical chemistry and Clinical Biochemistry)

1. Preparation of buffers; Acetate, phosphate and tris buffer.
2. Chromatographic techniques (Paper,TLC,Column)
3. Qualitative Tests for bio constituents in biological sample.
4. Estimation of cholesterol, urea and glucose in biological sample.
5. Estimation of Serum bilirubin by Diazo method.
6. Estimation of Hemoglobin.
7. Analysis of water: estimation of calcium and magnesium by EDTA method.

MS17BC107 : Laboratory cum Training- II (Enzymology and Microbiology)

1. Assay of salivary amylases,
2. Assay of Alkaline phosphatases
3. Assay of SGOT, SGPT and LDH.

4. Microscopic examination and chemical analyses of blood, urine and stools.
5. Isolation of air microflora Colony characteristics and Counting, pure culture techniques
6. Biochemical tests for microbial culture,testing water quality by microbial Method.
7. Bacterial growth curve.

II SEMESTERPAPER-I
MS17BC201:ENZYMOLOGY

Unit-1 52hrs

Introduction to Enzymes: Nomenclature and classification of enzymes. Mechanism of enzyme actions. Monomeric and oligomeric enzymes and multi- enzyme complexes with examples viz. Pyruvate dehydrogenase and fatty acid synthetase. Isoenzymes

The investigation of active site structure: The identification of binding sites and catalytic sites–trapping the E-S complex, use of substrate analogs, enzyme modification by treatment with proteolytic enzymes, photo – oxidation and chemical modification of amino acid side chains. The 3-D structural features of active sites.

13hrs

Unit-2

Factors affecting enzyme activity: pH, temperature, substrate concentration, enzyme concentration.

Enzyme catalysis: Chemical nature of enzyme catalysis-General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme catalysis.

Mechanisms of action of the following enzymes-lysozyme, ribonuclease, serineproteases and Triose phosphate isomerases.

Co-enzymes and cofactors: Water soluble vitamins and structure and function of their coenzymes.Metallo enzymes.

13 hrs

Unit-3

Enzyme kinetics: Kinetics of single substrate enzyme catalysed reactions; Michaelis Menton equation; determination of Vmax and Km values; Line-Steady State Kinetics, Eadie-Hofste plot; Kinetics of multi substrate enzymecatalysed reaction- reorder, order and Ping-Pong mechanism. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanisms.

Enzyme inhibition: Types-reversible, irreversible, competitive, non-competitive, mixed inhibition, partial inhibition, substrate inhibition and allosteric inhibition; irreversible inhibition.

14 hrs

Unit-4

Enzyme regulation: General mechanisms of enzyme regulation: Feed Back Inhibition and Enzyme repression control of enzymic activity by products and substrates; Allosteric enzymes, Sigmoidal kinetics and their physiological significance.

Fundamentals of enzyme assay – enzyme units, coupled kinetic assay. Criteria of purity of enzymes.

Industrial uses of enzymes: Amylases, cellulose degrading enzymes, proteolytic enzymes in meat and leather industry, detergents and cheese production; immobilisation of enzymes and their applications; introduction to biosensors.

12hrs

PAPER-II

MS17BC202: BIOTECHNOLOGY 52hrs

Unit-1
Recombinant DNA Technology
Introduction to recombinant DNA technology, importance of recombinant DNA technology, construction and screening of genomic and cDNA libraries, chemical synthesis of oligonucleotides, cloning vectors (λ -phage, plasmid, M-13 phage, cosmid shuttle, BAC and YAC vectors), properties of restriction endonucleases and their mode of action. **10 hrs**

Unit-2 Sequenicng
Sequencing OF DNA by Sanger's method, Principle and technique of pyrosequencing, Protein sequencing by Edman degradation method, site directed mutagenesis, RFLP,RAPD, PCR, DNA finger printing, Phage display , Yeast-two-hybrid (Y2H), Three hybrid assay. **10 hrs**
Unit-3
Gene transfer to plants: Plant tissue cell culture, hormones in plant tissue culture media, callus culture, Acclimatization of micro propagated plant. *Agrobacterium* mediated transformation, Ti plasmid, mechanism of T-DNA transfer, Function of T-DNA genes, Ti-plasmid derivatives as plant vectors (disarmed T-DNA), cointegrate and binary vectors, selectable markersfor plants, Direct DNA transfer to plants: protoplast transformation, particle bombardment, chloroplast transformation, electroporation. **11hrs**

Animal tissue culture: Cell culture media, monolayer and suspension culture, Gene transformation: Transfection, electroporation and liposome mediated transfer. *In vitro* fertilization and embryo transfer. Introduction to Transgenic animals, ethical issues regarding genetically modified organisms. **9hrs**

Unit-4

Fermentation technology

Primary and secondary metabolites in biotechnology, continuous and batch type culture techniques, principle types of fermentors, general design of fermentor, fermentation processes-brewing, manufacture of penicillin, production of single cell proteins, production strategies for other antibiotics and other organic compounds.

12 hrs

PAPER-III MS17BC203: IMMUNOLOGY

Unit-1

Introduction to Immune System

Memory, specificity, diversity, innate and acquired immunity, self vs non-self discrimination. Structure and functions of primary and secondary Iymphoid organs.

Cells Involved in Immune Responses

Structure and functions of Lymphocytes,Granulocytes,Macrophages,Dendritic cellsand mast cells

Nature of Antigen and Antibody

Antigen vs Immunogen, Haptens ,Structure and functions of immunoglobulins ,Isotypic, allotypic and idiotypipc variations.Clonal selection theory – concept of antigen specific receptor.

13 hrs

Unit-2

Humoral and Cell Mediated Immune Responses

Complement activation and its biological consequences, Antigen processing and presentation Cytokines and costimulatory molecules: Role in immune responses.T and B cell interactions.

Major Histocompatibility Complex (MHC) Genes and Products

Polymorphism of MHC genes, Role of MHC antigens in immune responses,MHC antigens in transplantation.

13hrs

Unit-3

Immunological Techniques.

Production of polyclonal and monoclonal antibodies: Principles, techniques and applications. Agglutination and precipitation techniques, Radio immunoassay, ELISA, Immunofluorescence assays: Fluorescence activated cell sorter (FACS) technique.

Hypersensitivity

Immune – tolerance, Immunosuppression, Hypersensitivity (Type I, II, III and IV).
13hrs

Unit-4

Immune Responses in Diseases

Immune responses to infectious diseases: viral, bacterial and protozoal, Cancer and immune system, Immunodeficiency disorders, Autoimmunity.

Immunization

Active immunization (immunoprophylaxis), Passive immunization (immunotherapy), Role of vaccines in the prevention of diseases**.** **13 hrs**

PAPER-IV

MS17BC204: BIOCHEMICAL GENETICS

Unit I

Introduction: Nature of genetic material. Chromosomes and genes. Mutation: types of mutation, mutagens, mechanism of mutation **3 hrs**

Classical Genetics: Review of classical genetics; work on Pisum sativum, Drosophila Melanogaster, Neurospora Crassa etc. inheritance (sex-linked and others). Population genetics, extranuclear inheritance. Sex determination, Morgan's discovery of sex linked inheritance of sex linked genes, X;linked traits in humans. Identification of sex chromo;somes, XX,XY, mechanism of sex determination. **10 hrs**

Unit II

Quantitative Genetics: Human quantitative traits, discontinuous traits and continuous traits,Breeding analysis, genetics basis of quantitative variation, Multiple factor hypothesis and analysis of polygenes. Genotype-Environment Interaction and models for their measurement, estimation of Heritability Index.

13 hrs

Unit III

Human Genetics: Biochemical events occurring during mitosis and meiosis. Structure of chromatin; nucleosomes and higher orders of organization. Chromosome banding, Chromosome mapping based on recombination frequency data. Transposons. Overview of human genome project, mapping of human genes; techniques used, assignment of important genes. Transposition in human chromosomes. Chromosomal abnormalities. **13 hrs**

Unit IV

Bacterial Genetics: Bacterial chromosomes, plasmids; fertility, resistance, colicinogenic and others. Recombination in bacteria**.** **5 hrs**

Viral Genetics: Life cycles of bacteriophages, lytic cycle; replication of T-phages. Lysogeny and its regulation. Transduction; specialized, generalized and abortive. Fine structure analysis of T-phages; Benzers work, concept of cistrons**.** **8 hrs**

PAPER-V MS17BC215:BIOINFORMATICS

Unit-1

Computer basics, Introduction, Scope of Bioinformatics and Biological data bases

- MS windows basics, UNIX basics.
- PC X Windows (NCD PCXWARE).
- File management.
- E-Mail (PINE, EUDORA, NETSCAPE MAIL).
- File transfer (ftp, WSftp).

Operating systems: System and application software, evolution of operating systems, layered structure of operating system, CUI and GUIs, DOS internet & external commands, Batch files.

Office applications: MS-office including MS-Word, MS-Excel, and MS-Powerpoint.
Data bases: Databases structure Organization and management of data bases, Data mining. Retrieval tools of biological data. Biological information resources, Nucleic acid and protein data bases.

13 hrs

Unit 2

Sequence Alignment and prediction of structure of protein
Database similarity searches: BLAST and FASTA**,** Sequence Alignment. Methods of local and global alignment. Dynamic programming, scoring matix, PAM, BLOSUM, Pairwise and multiple sequence alignment. Phylogenetic tree construction and software, Methods of prediction

of structure of protein and structure prediction softwares, Drug designing : Chemo-informatics in Biology.

13 hrs

PAPER – VI

MS17BC225: FOOD TECHNOLOGY **26hrs**

Unit 1

Introduction and Constituents of foods.

Food: source, functions of food – food groups – basic five food groups, usage of the food guide – food in relation to health – objectives of cooking.

Water: Purification processes – Ion exchangers, reverse osmosis, activated charcoal treatment. Use of chlorination, ozone, and UV light disinfection. Specification of drinking water. Water borne diseases – microbiological examination. Sources and detection.

Milk: Composition and effectiveness as a diet. Fat content in milk, whole and skimmed. Effect of cooking and heat processing of milk – pasteurization. Preservation of milk. Deep freeze preservation, dairy products – cheese, butter, ghee and kova. Spray drying technique – milk powder, infant food preparation. Lactose intolerance. Milk substitutes – vegetable milk. Toned milk.

Effect of cooking on the nutritive value of carbohydrate, protein, fat, vitamins and minerals food products. Emulsions and emulsifiers, rancidity of fats – chemistry of fat and oil processing , Fortification with vitamins and minerals. Effect of cooking on different methods of cooking of vegetables, fruits – dehydrated fruits, canned fruit, canned fruit juices. Estimation of thiamine,riboflavin (fluorimetry) and metals in tea dust. **13hrs**

UNIT 2:

FOOD ADDITIVES,ADULTERATION AND HYGIENE

Enzymes in food processing. Enzymic browning – mode of action and prevention of enzymic and non-enzymic browning. Artificial sweetening agents. rancidity of fats ; storage of fats. Fortification with vitamins and minerals.

Food Additives: Food additives: Artificial sweeteners – saccharin, cyclomate, asparatame –food flavours – esters, aldehydes and heterocyclic compounds. Antioxidants. Food colours – changes in cooking..Restricted use. Spurious colours. Emulsifying agents, preservatives – leavening agents.Baking powder –Yeast. Taste enhancers – MSG-vinegar Modern food: Mushroom cultivation and types, . Production of bread, bun and biscuits. Raw materials, methods and machinery required.Functions and uses of food additives.

Beverages: Composition of soft drinks. Preservation of tetrapack. Nitrogen preservation and packing of fruit juices.

Food Adulterants: Common adulterants in different foods – milk and milk products, vegetable oils, fats, spices , cereals and pulses. Prevention of food adulteration

Food preservation and processing : Food deterioration, methods of preservation and processing. Quality control: Specifications and standards: PFA, FPO, FDA, drug license, WHO standards, ISI ,AGMARK. **13hrs**

PAPER – VII

MS17BC206: LABORATORY COURSE– III (PROTEIN CHEMISTRY AND IMMUNOLOGY)

1. Isolation, separation and identification of protein/enzyme using thin layer chromatography.
2. Purification of an enzyme using column chromatography(ion-exchange columns/gel filtration/ affinity chromatography).
3. Estimation of protein by Lowry's method.
4. Estimation of tyrosine by Millon's method.
5. Molecular weight determination and kinetic studies on purified enzymes.
6. Demonstration of Ag-Ab interaction: Radial immuno-diffusion and ODD.
7. Demonstration of direct agglutination reaction using human blood group antigens.
8. Bacterial agglutination (WIDAL)
9. Antibody titration – ELISA; Direct, Indirect ELISA.
10. Rocket electrophoresis.
11. Protein synthesis in a cell free protein synthesizing system from animal and plant source.(industrial visit)

PAPER – VIII

MS17BC207: LABORATORY COURSE– IV (MOLECULAR BIOLOGYAND BIOINFORMATICS)

1. Isolation of DNA from cauliflower, sheep liver and bacterial source.
2. Isolation, separation, identification and Determination of molecular weight of Proteins by SDS-PAGE.
3. Writing a BASIC computer program to plot graphs of enzyme kinetic data by a variety of linear transforms and the Michaelis- Menten hyperbolic plot.
4. Prediction of structure of a biomolecule by using various softwares.(Rasmol, PDB,Identification of ligands/substrate through docking, chemsketch etc,…)
5. Subcellular fractionation of organelles from liver cells and identification by the use of marker enzymes.(industrial visit)
6. Separation of Protein in HPLC.

III SEMESTERPAPER-I
MS17BC301: MOLECULAR BIOLOGY 52 hrs

Unit -1
INTRODUCTION: Principle of DNA sequencing**,** automated sequencing, extending the sequence, shot gun sequencing.Interpretation of DNA sequences.Role of counterions, deep and narrow grooves, single stranded DNA, A, B and Z DNA etc. Chirality of the helix, syn/antiparallel complementary stands.
Physical properties of RNA: Classes of RNA, rRNA, tRNA, mRNA, HnRNA etc.
12hrs

Unit -2
DNA Replication: Replication origin and replication fork, mapping origin ofReplication by autoradiography and electrophoresis, semi-conservative and semi-discontinuous replication; DNA Polymerases, Semi-discontinuous synthesis,Replication apparatus of phage.Properties and functions of DNA polymerase-I,Korenberg enzyme,Subunit composition of polymerase –III holoenzyme,telomerase, topoisomerase and gyrase.
Genetic code;Properties of genetic code,coding properties of mRNA,Coding properties of tRNA, triplet binding assay, Khorana and Neirenberg experiments, base pairing between codon and ani-codon, Wobble base pairing., deviation from universal genetic code.
14hrs
Unit-3

Transcription in prokaryotes: RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).
Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification ofproteins).
15hrs
Unit -4

DNA Repair : Damaging agents and damagerecognition, direct repair, Miss-matchrepair assay for mismatch repair, Base excision repair(BER), Nucleotide excision repair(NER) systems; components and mechanism of repair, errorprone repair, SOS and Rec-A.
Satellite DNA: C-value paradox, possible functions of satellite DNA, Mechanical strength, gene library, suppressor mutation, centromeric DNA, split genes
Chromatin: Histone and non-histone proteins . Nucleosomes, role of H1.

11hrs

PAPER - II

MS17BC302: NUTRITIONAL BIOCHEMISTRY 52 hrs

Unit-1

Introduction of Nutrition: Energy concept of foods- Definition and characteristicfeature of balanced diet, proximate analysis of foods for carbohydrates, proteins, fats, fibre material.Determination of calorific value of foods, like carbohydrates, fats and proteins. Biochemical importance of R.Q. BMR, measurement of BMR, direct and indirect method, factors affecting BMR.

Biological Oxygen Demand: Definition and importance. Energy requirement for different physical activities. Standard Dynamic Action (SDA) of food. Recommended Daily Allowance (RDA) – Definition & for various food and physical activities. **15hrs**

Unit-2
Carbohydrates: carbohydrate reserves of the human body,nutritional importance of carbohydrates.

Proteins: Protein reserves of human body. Nitrogen balance studies and factors influencing nitrogen balance. Essential amino acids for man and concept of protein quality.Protein energy malnutrition: Marasmus, Kwashiorkor, causative factors, symptoms, treatment & prevention

Lipids: Major classes of dietary lipids. Properties and composition of plasma lipo-proteins. Dietary needs of lipids. Essential fatty acids and their physiologicalfunctions.

13hrs

Unit-3

Nutritional importance of vitamins: Classification, sources, daily requirement and functions. Hypervitaminosis of fat soluble vitamins

Nutritional importance of Minerals: Definition, classification, sources, daily requirement and deficiency, symptoms. The process of digestion, absorption, functions, toxicity interaction with other nutrients. **13hrs**

Unit-4

Biochemical aspects of oxidative stress and antioxidants. Free radicals- formation and biological importance in human system. Natural antioxidants, role of free radicals and antioxidants in health & diseases.

Starvation :. Protein metabolism in prolonged fasting. Protein sparing treatmentsduring fasting. Basic concept of high protein, low caloric weight reduction diets.

Obesity : Definition and classification. Genetic and enviromental factors leading to obesity. Obesity related related diseases and management of obesity. **11 hrs**

PAPER - III

MS17BC303: RESEARCH METHODOLOGY AND STATISTICS

52hrs

Unit-1

Methodology of scientific research.The nature of scientific methods.Quantitative biochemical measurements: Analytical considerations and experimental errors, nature of experimental errors- random and systemic errors. Identification of systemic errors, SOPs. Performance of analytical methods, precision, accuracy, detection limit, analytical range, specificity, sensitivity, and robustness. **13 hrs**

Unit-2 and 3

Quantitative biochemical measurements: Analytical considerations and experimental errors,nature of experimental errors- random and systemic errors. Identification of systemic errors, SOPs. Performance of analytical methods, precision, accuracy, detection limit, analytical range,specificity, sensitivity, and robustness.

Gaussian distribution (normal) of data, quantification ofprecision by standard deviation, coefficient of variation and variance, (data to be provided forcalculation of each parameter). Assessment of accuracy; Population statistics- confidence limitsand confidence intervals, student's t-test, standard error of mean, examples for calculation. Qtests,examples and applications, Null hypothesis, use of t-test tovalidate analytical methodsunpaired,paired, one-sample, two-sample tests with examples. Calibration methods; Least meansquare method of fitting straight line to data with example. Correlation and regression analyses.ANOVA, one way and two-way ANOVA.

Principles and practice of statistical methods in biological research, Basic statistics: samples and populations ,measures of average, measures of dispersion, standarderror, confidence limits; Probability distribution: normal, binomial and Poisson distribution; correlation and regression, test of statistical significance, and analysis of variance, Distribution of student's -t, chi-square (X2), F-test, latest software, introduction of software, exercise on biochemical problems **26 hrs**

Unit-4

Collection and review of research literature, sources of literature and their evaluation. Designing research methodologies. General strategies for preparation of research proposals. Data representation in technical reports, posters, presentation in scientific conferences and workshops. Preparation of manuscripts for publication in national and international journals. Yardsticks employed in evaluation of manuscripts for publications. **13hrs**

MS17BC304: BIOCHEMISTRY IN DAILY LIFE (For Other streams)

PAPER-V

MS17BC305: LABORATORY COURSE-III

1. Preparation of plasmid DNA from bacterial source.
2. Digestion by endonucleases and separation of DNA restriction fragment on agarose gel electrophoresis.
3. Ligation of DNA.
4. Isolation, quantification and characterization of total RNA from plant and microbial source.
5. DNA and RNA techniques using nitrocellulose - Southern and Northern Blotting.
6. Electroblotting of DNA restriction fragments.
7. Sequencing of DNA and RNA on polycrylamide gels.(Industrial Visit)
8. Rapid amplification of polymorphic DNA(RAPD).

9. Amplification of desirable gene by PCR
10. Real Time– Polymerase Chain Reaction RT-PCR. (Industrial Visit)
11. Preparation of competent cells.

MS17BC306- Project work-Dissertation

SEMESTER IV

Open Elective ICombination-1

MS17BC411: Pharmacovigilance

(Four hours per week, 4 credits)

Unit-1 (13hrs)

Drug Development Process

Drug discovery,Permulation and formulation,ICH-GCP Guidelines, ICMR Guidelines,USFDA guidelines, Indian Regulatory Authority Frame Work-CDSCO Regulations, DCGI,Data to be submitted along with the application to conduct clinical trials/import/manufacture of new drugs for marketing in the country, Data requiredto be submitted by an applicant for grant of permission to import and manufacture a new drug already approved in the country. Structure,Contents and Format for clinical study reports.

Unit-2 (13hrs)

Pharmacoepidemiology

Definitions: epidemiology, Disease distribution, disease determination, disease frequency, Aims of epidemiology, Difference between epidemiology and clinical medicines, Epidemiological approach, Measurements in epidemiology, (rates, ratios, and proportions) Measurement of mortality: international death certificate, limitationsand use of mortality data, mortality rates and ratios, crude death rates, specific death rates, case fatality ratio, proportional mortality ratio, survival rate, standardize rates, direct standardization, indirect standardization, Measurement of morbidity: Incidence, Prevalence, uses of prevalence, relationship between incidence and prevalence.

Unit-3 (13hrs)

Clinical Trial Management

Definition: Clinical Research, Different phases, study designs in research, glossary, Different parties involved in Clinical research, Regulatory Authorities, IRB/IEC, Sponsor, CRO, SMO, Investigator, Patients, Clinical Research History, Food, Drug & Cosmetic Act, Nuremberg Code, Declaration of Helsinki, ICH, Thalidomide Disaster

Different Regulatory Bodies- an overview, FDA, DCGI, MHRA, MHLW, TGA, IRB/IEC, Schedule Y, IND & NDA Application, Regulatory requirements & Forms, Clinical Trials process & monitoring,Roles of different parties, Clinical Trialprocess and design, Informed Consent Process, TMF (Trial Master File), Investigator Boucher, Essential Documents

Unit-4 (13hrs)

Clinical Data Management

CDM Overview, CRF Design – Theory & Practical Design of the pCRF (Paper CRF) &eCRF (electronic CRF), Data Entry & DE Guidelines, Discrepancy Management, Data Validation, CDISC (SDTM), Query Management, QA, QC in CDM, Audits & Inspections (Indian DCGI & USFDA), SAE Reconciliation, Data Management Systems and Tools, Medical Coding and Medical Dictionaries – MedRA& WHODD, Documentation and Document Management System, Data Archival, Software's in CDM, CDM

<u>MSBC16F4200: SAS Technique</u> 52 hrs

Unit-1 (13hrs)

Pharmacovigilance

Introduction, Scope, definition and Aims of Pharmacovigilance.Adverse drug reactions – Classification, mechanism, predisposing factors and casualty assessment. Role ofclinical pharmacist in Reporting, evaluation, monitoring, prevention and management of ADR Adverse drug reaction.Signal detection, PSUR (Periodic safety update report),Safetyspecification,and Risk management.Eporting and monitoring Drug induced diseases.

Unit-2 (13hrs)

Introduction and use of SAS

Environment of SAS, Library structure in SAS, Data steps and Procstep,manipulating the data-Converting the numeric data to character and vice versa.Using logical operators and where conditions, Merging of the datasets, Writing the data into multiple datasets.Debugging errors in the program.Writing the procedure- Tabulate, Univariate, Means, Median, Mode, Report, Sort, Mixed, Transpose etc. Creating the html reports.Importing the data to SAS and exporting the data from SAS.Overview of SAS macros.

Unit-3 (13hrs)

Regulatory Affairs

Basic Fundamentals of Regulatory Affairs, Introduction to Regulatory Bodies, Introduction to Quality Standards for Regulatory Compliance, Common Technical Documents - CTD (API & Formulation), Introduction to eCTD, ASEAN Common Technical Dossier (ACTD), Marketing Authorization Procedures in USA, Marketing Authorization Procedures/ Channels in Europe, Marketing Authorization Procedures in India, Marketing Authorization Procedures in ROW markets, Maintenance and Annual updates for Marketing authorizations, Reference on Further reading & Dissertation

Unit-4 (13hrs)

Medical & Scientific writing

What is Medical Writing, Scope of Medical Writing, Medical Writing in Clinical trials, Medical Writing and Scientific Writing, Fundamentals of Medical Writing, Regulatory Medical Writing, The Writing Process, Good Writing Skills:Introduction to basic rules, Elements of style

Good Clinical Practice guidelines, The Clinical Study Report

Introduction to publication writing, Regulations and Industry Standards, Writing Effective Documents, Writing standard operating procedures policies, procedures, instructions and methods, Writing quality manuals and plans

Open Elective IICombination-2

MS17BC421:Clinical Diagnostics

52hrs

Unit-1
Human Physiology

Rhythmical excitation of heart, basic theory of circulatory function, blood flow and resistance, function of arterial and venous systems

Microcirculation and lymphatic system, control of blood flow, regulation of arterial pressure, cardiac output.

Spinal cord and motor functions, role of brain stems in controlling motor functions, functions of cerebellum, functions of cortical areas, the limbic system and cerebrospinal fluid system.

Medico -informatics

Introduction to Medical Network Design & Development Emergence of Medical Informatics as a Discipline; Library facilities & Logistics ; Online Resources ; Grading and Class Policies, Medical data acquisition and database systems: PC based multichannel data acquisition system; storage, analysis and retrieval techniques.

Basics of sequence analysis-

Dot matrix method, Needleman–Wunsch Algorithm and Smith-Waterman algorithm, Alignments using BLAST and FASTA, Multiple Sequence Alignment (CLUSTAL-X and CLUSTAL-W), Application of multiple sequence alignment. **13hrs**

Unit-2

Analysis tools: Analysis by TreeView, Genedoc and Lasergene. Protein Structure Prediction in Bioinformatics- Ab initio based methods, Homology based methods, prediction with neural networks, secondary structure prediction (helical membrane proteins, beta-barrel membrane proteins). Protein structure comparison of intermolecular and intramolecular methods Phylogenetics- construction by distance based methods, character based methods.

Visual programming concepts

Visual Basic environment, tools and controls; Dynamic data exchange; VB based Medical information System. Basic concepts of Multimedia; Design of Multimedia information systems; Components of virtual reality; Virtual reality applications in medicine. Medical Informatics and its levels; Design and development of educational packages on medical sciences; Integrated design concepts; Interactive multimedia,Virtual and digital libraries, Internet and its applications.

Hospital Information System its design and functional characteristics; Pattern Recognition, Neural Network and Fuzzy Logic in Medicine. Autonomous, Decision-

Support & "Expert" System: History of Artificial Intelligence in Medicine; Expert Systems in Medicine; Clinical Software Overview Risks of Decision-Support Systems,Computational Statistics in medical biology. **13hrs**

MS17BC421: CLINICAL BIOCHEMISTRY **52 hrs**

UNIT - 1

Concepts of accuracy, reproducibility, reliability and other factors in quality control: Specimen collection and processing, collection of blood- venepuncture, arterial puncture and anticoagulants. Collection and analysis of normal and abnormal urine samples, preservation, clinical significance of sugars, ketone bodies, proteins & bilirubin. Theories of CSF collection, composition and analysis.

Disorders of carbohydrate metabolism: Blood sugar levels, hyper and hypoglycemia, regulation of blood glucose level. Diabetes mellitus- types, causes and symptoms. GTT, HbAIC, GSD, HMP Shunt, fructosuria & fructose intolerance.

Disorders of lipid metabolism: Lipid levels in various conditions, lipoproteins,clinical inter-relationship of lipids.

Diagnostic tests for apolipoproteins, HDL-C, LDL-C, and triglycerides levels in healthy& diseases conditions. Hypercholestremia, fatty liver and myocardial infarction.

Disorders of protein metabolism: Non-protein nitrogenous constituents in blood- urea, uric acid & creatinine. Plasma protein abnormalities, multiple myeloma, proteinuria, haemoglobinopathies, PKU, AKU, homocystinuria, albinism & Bence Jones proteins. **13hrs**

UNIT - 2

Disorders of nucleic acid metabolism: Disorders of purine metabolism- Gout- causes & symptoms, xanthinuria, orotic acidic uria & L-N syndrome.

Disorders of mineral metabolism: Hypercalcemia, hypocalcemia, hypophosphatemia& hyperphosphatemia.

Disorders of vitamins & trace elements: Hypervitaminosm- causes & symptoms, trace elements deficiency disorders.

Evaluation of organ function test: Assessment and clinical manifestation of renal, pancreatic, gastric and intestinal functions.

Disorders of heme metabolism: Jaundice- types, causes & symptoms. Clinical importance of diagnostic enzymes- SGOT, SGPT, creatine kinase, aldolase, LDH, CPK, troponin 'C'

Renal and gastric functional test: Acute and chronic renal failure, urinary tract, observation and analysis of urinary calculi, LFT, pancreatic and gastric function test.

13hrs

Open Elective IIICombination-3

MS17BC431: PLANT BIOCHEMISTRY

52hrs

Unit-1

Structure and functions of plant cell (including cell wall, plasmodesmata, meristematic cells, vacuoles, secretary systems and root quiescent zone), Isolation of cell organelles, absorption, adsorption and transport of water and ions in plants. Evapotranspiration.

Biological nitrogen fixation and ammonia assimilation.Nitrate and sulphate reduction and their incorporation into amino acids.Translocation of inorganic and organic substances.Metabolism of sucrose and starch. Important routes (pathways) of biosynthesis- phenyl propanoid pathway; Mevalonate pathway; Acetate-mevalonate pathway

Photosynthesis – structure of organelles involved in photosynthesis in plants and bacteria. Proton gradients and electron transfer in chloroplasts of plants and in purple bacteria – differences from mitochondria. Light receptors – chlorophyll, light harvesting complexes, bacteriorhodopsin, rhodopsin as ion pump.

Photosystems I and II, their location, mechanism of quantum capture and energytransfer between photosystems – ferridoxin, plastocyanin, plastoquinone, carotenoids.The Hill reaction, photophosphorylation and reduction of CO_2.C_3, C_4 and CAMmetabolism, light and dark reaction. Light activation of enzymes, regulation ofphotosynthesis. Photorespiration.

13hrs

Unit-2

Special features of secondary plant metabolism, formation of phenolic acids, tannins, lignins, lignans, pigments, terpenes, terpenoids, plant phenolics, alkaloids and surface waxes – their biosynthesis and function, cell wall components.

Plant hormones – Growth regulating substances and their mode of action. Molecular effects of auxin in regulation of cell extension and of gibberllic, abscisic acids and cytokinins in the regulation of seed dormancy, germination, growth and development and embryogenesis. Biochemistry of seed development and fruit ripening. Defence system in plants. Tissue culture and transgenic plants.

Plant responses to biotic and abiotic stresses:Introduction; Plant pathogens and diseases; plantdefense systems-hypersensitive response; systemic acquired resistance; induced systemic resistance; Plant abiotic stress responses-Salt stress, drought and heavy metal stress responses; osmotic adjustment and significance of osmotic agents such as proline, sugar alcohols andquaternary ammonium compounds; An overview ofoxidative stress and oxidative damage. Antioxidant enzymes and stress tolerance. Plant biotic stress response – pathogen and insects.

13hrs

MS17BC431: INDUSTRIAL BIOCHEMISTRY

52hrs

Unit-1

Nanobiotechnology: Types of nanoparticles, DNA based nanostructures, nanosized carriers for drug delivery. Role of nanoparticles in drug delivery. Nanobiotechnology in gene therapy, tissue engineering andtransplantation.

Pharmaceutical biochemistry and vaccine development

Development of new drug/molecules and elucidation of their mechanisms of actions; formulations; pharmacokinetics and pharmacodynamics; factors affecting drug efficacy drug resistance; traditional medicines; biotransformation; large scale production of humanized monoclonal antibodies; vaccine development.

Food biochemistry

Introduction to different categories of food; constituents of food products and their functional properties; introduction to food processing;food spoilage; intrinsic and extrinsic factors affecting the quality and life of food material; food storage and preservation techniques; food poisoning; molasses and alcohol production.Industrial production of proteases; carbohydrases; lipases and their applications, vaccine production by rDNA technology; downstream processing.

13 hrs

Unit -2

Fermentation technology- surface, submerged and continuous culture techniques. Design and operation of fermentors, Agitation and Aeration, selection and growth of microorganisms in controlled environments, medium development. Strategies for improvement and maintenance of the industrial strains, Bioreactors.

Production of fermented milks, cheese, alcoholic beverages, breads by yeast. Fermentation production of Antibiotics- pencillin, streptomycin, Organic acid, citric acid, lactic acid, Enzymes –amylase, proteases, Amino acid-glutamic acid, lysine and Vitamins- B12 and vitamin C .

Microbial transformation

Types, techniques and commercial applications. Bioleaching and biosorption, Biodegradation and Bioremediation, Biomass and Bioenergy, Biopolymers and Biosurfactants. Enzyme electrodes and biosensors. Sewage water treatment – primary, secondary and tertiary treatments. Bio-control agents- Insecticidal toxins of Bacillus thuringenesis.

Bioethics and Biosafety, biosafety guideline and regulations, animals in research, Legal and socio-economic impacts of Biotechnology, Ethical, legal and social implications (ELSI) of HGP.Ethics in clinical trials. Intellectual property rights and protections for biological inventions. Patent and process involved in patenting.

13hrs

MS17BC402: Laboratory cum Training- VI(Genetic Engineering)

1. Digestion of endonucleases and separation of DNA restriction fragment on agarose gel electrophoresis.
2. Ligation of DNA
3. Blotting Techniques:Southern and Northern
4. DNA amplification by PCR.
5. Random Amplification of polymorphic DNA.
6. Plant tissue culture independent method of transformation.
7. Sequencing of DNA and RNA on polyacrylamide gels.

MS17BC403: Project work-dissertation (continued from III Semester)

SUGGESTED READINGS FOR M.Sc.BIOCHEMISTRY
I SEMESTER

MS17BC101: ORGANIC, BIOPHYSICAL CHEMISTRY, BIOCHEMICAL AND ENVIRONMENTAL TOXICOLOGY

1. Stereo chemistry of organic compounds (1994) by E L Eliel & SHW Awley. Inter Science Pub.30. Wiley and sons.Inc.
2. Organic Chemistry (6^{th} ed. 2000) by R T Morrison & R N Boyd. Prentice Hall of India. New Delhi.
3. Organic Chemistry Vol.1 Fundamental Principles (6^{th} Ed. 2003) by IL Finar, ELBS
4. Organic Chemistry, 11^{th} edition 2014, by T W Graham Solomons, Craig B Fryhle and Scott A Synder.
5. Organic chemistry by Stanley H. Pine (4^{th} Edition, 1987) Tata Mc-Graw hill.
6. Vol.2 Stereo Chemistry and the Chemistry of Natural Products. (5^{th} ed. 1985) by I L Finar, ELBS.
7. Lehninger's Principles of Biochemistry (2^{nd} Ed 2000) D L Nelson and M M Cox, Macmillan Worth pub. Inc NY.
8. Physical Biochemistry by Kansal Edward Van Holde (1971) Prentice Hall Inc. New Jersey.
9. Physical biochemistry 2^{nd} nd (1982) by David Friedfelder, W H Freeman and Co. NY.

10. General and Applied Toxicology 1995 by Marrs and Turner. Macmillan Press Ltd.
11. Basic Envionmental Toxicology (1994) by Lorris G. Corkerhem and Barbara S S Shane CRP Press Inc.
12. Introduction to Food Technology by Talayurki Shibamato & Leonard F Bzeldanes.
13. Molecular Biotechnology 2nd ed 1994 by Barnard R Glick & J J Pasternak.

MS17BC102:GENERAL PHYSIOLOGY

1. Molecular Biology of the Cells (3rd edn 1994) by Alberts et al., Garland Publications inc NY and London.
2. Cell Biology (1993) by E S Sedava, Jones and Barlett Publishers Boston, London.
3. Cell and Molecular Biology (8th ed. 2001) by E D P de Robertis & E M F de Robertis (Jr) Lippincott Williams &Wilkins, Philadelphia.
4. Principles of Cell Biology (1988) by Klein Smith and M.Kish. Harper-Cellins Pub. Inc. New Delhi.
5. Text book of Medical Physiology (10th ed. 2001) by A C Guyton & J E Hall. Harcourt Asia.

MS17BC103: BIOENERGETICS AND INTERMEDIARY METABOLISM

1. Lehninger's principles of Biochemistry (2nd edn. 2000) by D L Nelson and M M Cox, Macmilian, Worth Pub Inc.
2. Biochemistry (4th edn. 1992) by Lubert Stryer WH Freeman & Co., NY.
3. Harper's Biochemistry (25th ed.) by R K Murray and others. Appleton and lange, Stanford.

MS17BC104: ANANLYTICAL TECHNIQUES

1. Instrumental methods of analysis H.H.Wilard,L.L.Merritt, J A Dean.
2. Instrumental Methods of Chemical analysis.
3. Analytical Chemistry G.D. Chritiain. Wiley
4. Introduction of instrumental analysis. R.P.Braun
5. Biophysical chemistry by Upadhyay and Upadhyay .
6. Principles and Techniques of Practical Biochemistry byKeith Wilson, John Walker, 5th Edition, 2000. Cambridge Univ.Press
7. Organic Spectroscopy by Willium Kemp,3rd edition 2008.
8. Essentials of Nuclear Chemistry- H.J.Arnikar
9. A text book of quantitative Inorganic analysis A I Vogel.
10. Pharmacopoeia of India , British Pharmacopoeia
11. Standard methods of Chemical analysis A Series of Volumes Edited F.J.Welcher R.G. Krieger publ-Company.
12. Principles of Instrumental Analysis Fifth edition Skoog, Holler, Niemay

13. Principles and techniques of practical Biochemistry. K.Wilson and J. Walker. 4thEdn. Cambridge University press (2012).

II SEMESTER

MS17BC201:ENZYMOLOGY

1. The chemical kinetics of enzyme action by K J Laidler and P S Bunting, Oxford University Press. London.
2. Enzymes by M Dixon, E C Webb, CJR Thorne and K F Tipton, Longmans, London.
3. Enzyme structure and mechanism (1977) by Alan Fersht, Reading, USA.
4. Enzymatic reaction mechanism (1979) by Cheristopher Walsh, freeman Pub., San Francisco.
5. Immobilized enzymes (1978) by Ichiro Chibata, Haisted Press Book.
6. Enzyme structure and function by S Blackburn (1976) marcel Dekker, Inc., NY.

MS17BC202: BIOTECHNOLOGY

1. Biochemistry (2nd ed 1995) by Donald Voet and Judith Voet.
2. Molecular Biology of the gene (IV ed 1987) J Watson NH Hopkin JW Roberts J P Stertz A M Weiner, FreemanPub., San Francisco.
3. Genes VII Benjamin Lewin (2000) Oxford Univ Press. London.

MS17BC203:TECHNICAL WRITING, COMPUTERS AND BIOINFORMATICS

1. Discovering Genomics, Proteomics and Bioinformatics, Campbell A M & Heyer L J, 2nd Edn. Benjamin Cummings, (2007).
2. Protein Bioinformatics; M. Michael Gromiha, Academic Press (1983).
3. Principle and Practice of Bioanalysis; Richard F. Venn (Ed.) Taylor and Francis (2000).
4. Attwood, T. and P.S. David. 2006. Introduction to Bioinformatics. Pearson Education Ltd.,New York.
5. Baxevanis, A.D., and Ouellette, B.F.F. (eds) 2006. Bioinformatics A Practical Guide to Analysis of Genes and Proteins. 3rd Edition, John Wiley and Sons, New York.
6. Attwood T.K. and Higgs, P.G. 2005. Bioinformatics and molecular evolution. Blackwell Publishers, London.
7. Lesk, A.M. 2002. Introduction to Bioinformatics. Oxford University Press

MS17BC204:IMMUNOLOGY

1. Immunology (4th edn. 1998) by Ivan Roitt, J Brostoff and David Mole (4th edn) Mosby Times Mirror Int. Pub.Ltd.
2. Essential Immunlogy (9th ed. 1997) by Ivan Roitt Blackwell Science Ltd.
3. Immunology (1992) by Janis Kuby W H Freeman and Co. Ltd. USA.

4. Immunology (2nd edn. 991) by Edwards S Golub, Sinauer Associate, Sunderland.

MS17BC225:FOOD TECHNOLOGY

5. Swaminathan M. Advanced Text Book on Food and Nutrition , volume I and II Printing and Publishing CO., Ltd., Bangalore. 1993.
6. Swaminathan M. Text Book on Food chemistry, Printing and Publishing CO., Ltd., Bangalore. 1993.
7. Norman N. Potter , Food science, CBS publishers and distributors, New Delhi. 1994.
8. Lillian Hoagoland Meyer, Food Chemistry, CBS publishers and distributors, New Delhi. 1994.
9. Owen R Fennema, Food Chemistry, Marcel Decker Inc., New York. 1996.
10. Srilakshmi B., Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.
11. Siva Sankar B., Food Processing and Preservation. Prentice – Hall of India Pvt. Ltd., New Delhi. 2002.
12. Ramakrishnan S., Prasannam K.G and Rajan R –Principles. Text book of medical biochemistry. Orient Longman Ltd. III ed. 2001.
13. Shakuntala Manay N. and ShadaksharaswamyM. FOODS: Facts and Principles. New age International Pvt. Ltd. Publishers

III SEMESTER

MS17BC301: MOLECULAR BIOLOGY

1. Molecular cloninig:a laboratory manual (Vol.1,2&3) 1989) by T.Maniatis, E.F.Fritsch, J. Sambrook. Cold SpringHarbor Laboratory Publications.
2. RNA Isolation and Analysis by P.Jones, J.Qiu, D.Rickwood (1st ed.1994) Bios Scientific Publishers.
3. Gene and Probes: A practical Approach Series (1995) by B D Hames and S J Higgins. Oxford universityPress.
4. Gel Electrophoresis of nuclei Acids: A practical Approach (1990) by D.Rickwood and B.D.Hames. OxfordUniversity Press.

MS17BC302:NUTRITION BIOCHEMISTRY

1. Nutrition: An integrated approach (3rd edn. 1984) R L Pike and M L Brown, Wiley & Sons Inc., NY.
2. Text Book of Biochemistry and Human Biology G P Talwar, Prentice Hall.
3. Mechanism and Theory is food chemistry (1996) DWS Wong, CBS, New Delhi.
4. Text Book of Human Nutrition (1996) M S Bamji N Pralhad Rao and V Reddy, Oxford & IBH Publishers.
5. Nutritional Biochemistry and Metabolism Linten.
6. Principles of Food Science-l (Food chemistry) Fennemona D R.
7. Human Nutrition and Dietetics (8th Ed. 1982) by Davidson and Passmore ELBS.

8. Modern Nutrition in Health and Diseases (7th ed. 1988) by Maurice E Skills and V R Young K M VargheseCo. Bombay.

MS17BC303:RESEARCH METHODOLOGY AND BIOSTATISTICS

1. Biostatistics : A foundation for analysis in the health. (7th ed. 1999) by W W Daniel John Wiley and Sons Inc.,New York.
2. Choosing and Using Statistics; A Biologist Guide, Clavin Dythan, Blackwell Scientific(1999).

IV SEMESTER

MS17BC411:PHARMACOVIGILANCE AND SAS TECHNIQUE

1. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
2. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
3. Clinical pharmacokinetics, Pub. Springer Verlab, Dr. D.R Krishna, V. Klotz
4. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins
5. Drug interaction, Kven Stockley. Hamsten
6. Drug interaction, Basic Bussiness Publ, Bombay, J.K. Mehra
7. Clinical pharmacology and drug therapy Grahame smith and Aronson,
8. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms,
9. Clinical Pharmacy and therapeutics Herfindal E T and Hirschman JL, Williams and Wilkins

MS17BC421:CLINICAL DIAGNOSTICS & CLINICAL BIOCHEMISTRY

1. R. D. Lele, “Computer in Medicine”, Tata McGraw-Hill, New Delhi, 1997.
2. Tay Vaughan, “Multimedia making it work’, Tata McGraw-Hill, New Delhi, 1997.
3. Davis Chapman, “Teach Yourself Visual Basic 6 in 21 days”, New Delhi, 1997.
4. Harold Sackman, “Biomedical Information Technology’, Academic Press, New York, 1997.
5. Tietz Fundamentals of Clinical Chemistry – (5th edn.) C A Burtis, E R Ashwood (eds.) Saunders WB Co.
6. Notes on Clinical Chemistry – Whitby L G, A F Smith, G J Beckett, S M Walker, Blackewll science Inc.
7. Practical Clinical Biochemistry methods and later ,3rd edition,2003,2006 by Ranjna Chawla.

8. Practical Clinical Biochemistry,4th edition,2005,by Harold Valley.
9. Practical Biochemistry-Principles and Techniques,5th edition by Keith Wilson and John Walker(2000).
10. Introductiory Practical Biochemistry-3rd edition,2005 by S.K.Sawtrey,Randhir Singh.
11. Biochemical Methods- 3rd edition,2008,by S.Sadasivan and A.Manickam.
12. Experimental Biochemistry,3rd edition,2003, by Robert Switzer and Liam Garrity.
13. Text Book of Biochemistry and Human Biology,3rd edition,2006 by G.P.Talwar and L.M.Srinivastava.

MS17BC431: PLANT BIOCHEMISTRY& INDUSTRIAL BIOCHEMISTRY

1. Handbook of photosynthesis (ed) mohammad pe sarakle, marcel Dekkar, Inc.NY. Basel. Hong Kong 1997.
2. Introduction to plant biochemistry (1983) T W Goodwin and E I mercer.Pergaman press, Oxford, NY< Toronto,Sydney, Paris, Frankfurt.
3. Seed: physiology of development and germination (2nd ed. 1994) J D Bewleyand M Black Plenum Press.
4. Biochemistry of energy utilization in plants D T Dennis Blackie, Glasgow andLondon 1987.
5. Industrial Microbiology by Prescott, 4th ed. CBS Publishers.
6. Biotechnology by Crueger, PANI Publishers.
7. Principles of Fermentation Technology by Stanbury .
8. Industrial Microbiology by A.H.Pate
9. Plant Biochemistry by P M Dey and J B Harborne. Harcourt Asia PTE Ltd.,Singapore.

Career Development and Placement

Having a degree will open doors to the world of opportunities for you. But Employers arelooking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing s kills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills throughvariety of training programs and such other activities that induce the said skills among all students.

A full-fledged Career Counselling and Placement division, namely Career Development Centre (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counsellors and placement officers and other efficient supportive teamdoes handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together ina team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Commerce is efficient leaders of repute, who can dealthe real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with thecurriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. Theprocess involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and March forward to make better career. The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities.

Through this skill development centre the students shall compulsorily complete at leasttwo skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has signed MOU's with research organizations and universities abroad to facilitate greater opportunities of employability for conducting certification programs.

REVA UNIVERSITY

Bengaluru, India

SCHOOL OF PERFORMING ARTS

MFA Bharatanatyam

Handbook

2017-2019

SCHOOL OF PERFORMING ARTS

MASTER OF FINE ARTS

(Bharatanatyam)

2017-2019

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Kattigenahalli,Yelahanka, Bangalore-560064
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Rukmini Educational
Charitable Trust www.reva.edu.in

Chancellor's Message

“Education is the most powerful weapon which you can use to change the world.”

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when ‘intellectual gratification’ has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of ‘Knowledge is Power’, we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I’m always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said ‘A University should be a place of light, of liberty and of learning’. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor’s Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.

A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this ‘temple of learning’ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of REVA University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS".

Welcome to the portals of REVA University!

Dr. S. Y. Kulkarni

Vice-Chancellor, REVA University

DIRECTOR'S MESSAGE

The freedom that students are getting to choose their careers now is much broader than ever before. Unconventional career choice is the new way, and the Gen Y is all about wonderful creativity. School of Performing Arts, aims to benchmark itself in the area of Music, Dance and Theatre courses from the Diploma to Research level degrees. Indian tradition in which Music and Dance plays a pivotal role is a major attraction and a focus of study for not only Indians but westerners too, for, one finds it very scientific and vast area for inter-disciplinary research activities. Department is well equipped to meet the traditional and modern needs of both Indian and foreign nationals. The performing wing of the school shall aim to churn out the most sought after performers and especially thinking dancers. The syllabi is world class and prepares students not just as performers but also in the areas like research, Art Management, Personality development, soft skills, Music, Nattuvangam, Theatre studies and other allied art forms, apart from bringing in internationally acclaimed artistes for workshops, guest lectures and interactive sessions. The field work and Dissertation makes the course rigorous and unparalleled.

The curriculum caters to and has relevance to local, regional, national, global development's needs. Maximum number of courses are integrated with cross cutting issues with relevant to professional, ethics, gender, human values, environment &sustainability.

I take this as my privilege to welcome the artistes and connoisseurs to come and explore the finer aspects and unexplored world of Performing Arts at REVA University

Dr Vasanth Kiran
Director, School of Performing Arts

CONTENTS

RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. **Rukmini Educational Charitable Trust** (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology, among others. In furtherance of these objectives, the Trust has set up the REVA Group of Educational Institutions comprising of REVA Institute of Technology & Management (RITM), REVA Institute of Science and Management (RISM), REVA Institute of Management Studies (RIMS), REVA Institute of Education (RIE), REVA First Grade College (RFGC), REVA Independent PU College at Kattigenahalli, Ganganagar and Sanjaynagar and now REVA University. Through these institutions, the Trust seeks to fulfil its vision of providing world class education and create abundant opportunities for the youth of this nation to excel in the areas of Arts, Architecture, Commerce, Education, Engineering, Environmental Science, Legal Studies, Management and Science & Technology.

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top notched educational institutions was born of the philanthropic instincts of Dr. P. Shyama Raju to do public good, quite in keeping with his support to other socially relevant charities such as maintaining the Richmond road park, building and donating a police station, gifting assets to organizations providing accident and trauma care, to name a few.

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 15,000+ students study various courses across REVA’s three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 24 Post Graduate Degree programs, 21 Degree programs in various branches of studies and has 14000+ students studying in various branches of knowledge at graduate and post graduate level and 410 Scholars pursuing research leading to PhD in 21 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated

many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Censor Networks, Computer Networks, IOT, MEMS, Nano-Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano-materials, Photonics, Nana Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counsellors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The

Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC[2], VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms. To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran

Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organises yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honors and recognitions.

ABOUT SCHOOL OF PERFORMING ARTS

India proudly treasures the rich heritage and culture which is unparalleled and incomparable. Indian arts play a pivotal role and Performing Arts stands as testimonial to the richness. Performing Arts which comprises of Music, Dance and Theater are in demand for career choice now like never before. REVA-SPA offers a unique challenging Performing Arts programs which prepares you future ready. The aim is to bring in holistic view to the performing arts education in India, which is predominantly missing. The school of Performing Arts offers courses like Certificate, Diploma, MPA (Masters of Performing Arts) and Ph. D programs. Our Syllabus is world class and is benchmarked. The SPA is in beautiful campus of REVA University, which has received Best Campus awards in India and Best upcoming university awards. Performing Arts school would also concentrate on collaborating with universities abroad for short terms and semester exchange programs and also introduce Indian Performing Arts to the foreign students. Internationally acclaimed artistes visit campus often as visiting faculty members and guest lectures to interact with students. The performing wing at school of Performing Arts will have performing opportunities all over the country and abroad. Students can expect to become thinking artistes and professional in approach. The seminars, workshops, guest classes would make them ready to face the world of Arts that is an amalgamation of a spectrum of experiences and choices.

USP of Programs run by School of Performing Arts

- Full time dedicated and highly experienced dance and music faculty members.
- Exclusively dedicated floor for School of Performing Arts in the Rukmini Knowledge Park campus.
- Well-equipped library with hand picked books and Sanskrit Volumes on treatises in Dance, Music and Theatre along with News Papers, Journals, Magazines, Books, e-resources etc., on Performing Arts.
- Audio and Video Facility in all the classrooms.
- Aesthetically designed and acoustically planned classrooms with Modern German Dance flooring for injury free dancing.
- World Renowned artists as Visiting Lecturers and Adjunct Faculty.
- World renowned Artists for lecture demonstratins and Workshops under “Kala Gnana”, monthly series conducted in the School of Performing Arts for the benefit of Students.

- Training and exposure to Research and Publications – students are trained by their mentors on presenting their research papers in confereneces and seminars. They are also trained to publish research papers in reputed journals.
- Certification and training programs for CBSE UGC NET exam.
- Training in Sanskrit, Telugu and Kannada as part of their curriculum.
- Language Labs
- Well equiped Psychology Labs
- Well planned and challenging syllabus.
- Performing opportunities at the prestigious Festivals in India and Abroad as part of Performing wing of the School of Performing Arts.
- State of the Art facilities for Locker rooms, Changing rooms and Green rooms.
- Mandatory Mentor and Mentee sessions by faculty members every week every week for the benefit of the students.
- Dediacted auditoriums with International standards.
- Global program with an opportunity to pursue a short term or a semester in one of our partnered Universities in USA, Europe etc.,
- Oportunity to also participate in Inetr University competetions at State, National and International leves representing the University.
- Dedicated Skill Development cell that focusses on career oriented Programs exclusive for Performing Arts Students.
- Special Training in Allied forms like Stage Craft, Sound System, Lighting, make up and Costumes etc.
- Every year field Trips for the stduents along with the faculty members to Historically rich Art places.
- Mandatory Internship Programs for UG and PG Students.

VISION

School of Performing Arts aims to be Centre of Excellence in Performing Arts through high quality education, research, innovation, creativity, extension and collaboration and prepare students who would be great performers and innovators and create global village of peace and prosperity by spreading the message of Indian culture and tradition.

MISSION

- To impart holistic performing arts education by matching the contemporary world requirements with traditional pedagogical techniques.
- Attract and develop talented and committed human resource and provide an environment conducive to research, innovation and team spirit.
- Develop excellent infrastructural facilities; facilitate effective interaction among faculty and students with other schools and promote inter disciplinary learning and research environment.
- Practice and promote high standards of professional artistry with ethics and enrich personality traits of students to become great performers coupled with moral values.
- Foster networking with alumni, artists and art institutions across the world and other stake holders and spread the message of Indian culture and tradition for global peace and prosperity.

ADVISORY BOARD

SL No.	Name
1.	Dr. S Ramaswamy, Professor[Retd] Bangalore University, Bangalore
2.	Dr. V. S. Sreedhara, Professor of English , NLSUI, Bangalore
3	Dr. Shivalinga Swamy, Associate Professor and HoD of English, Tumkur University, Tumkur
4.	Dr. Etienne Rassendren, Professor, Dept of English, St Joseph's College[Auto], Bangalore
5	Dr. C. P. Ravichandra, Professor, Dept of English, Mysore University, Mysore
6	Dr. Rajendra Chenni, Professor. Dept of English, Kuvempu University, Shimogga
7	Prof. S. Narayanan, Professor [Retd], Kongadiappa College, Doddabalapura

"Education is the manifestation of the perfection already in man"

- Swami Vivekananda

The ladder of success is best climbed by stepping on the rungs of opportunity.

- Ayn Rand

I think of science fiction as being part of the great river of imaginative fiction that has flowed through English literature, probably for 400 or 500 years, well predating modern science.

- J. G. Ballard

Literature adds to reality, it does not simply describe it. It enriches the necessary competencies that daily life requires and provides; and in this respect, it irrigates the deserts that our lives have already become.

- C. S. Lewis

Literature is the art of discovering something extraordinary about ordinary people, and saying with ordinary words something extraordinary.

- Boris Pasternak

MASTER OF FINE ARTS (MFA)
Bharatanatyam

Programme Overview

Performing Arts discipline deals with human life and human experience qualitatively. Humanities investigates how do human beings behave? Why do they behave this way? How do human beings interact with each other? How do human beings interpret the world around them? And what kind of political, social and cultural institutions do they form?

The field of humanities include Modern languages, Classical languages, Linguistics, Literature, History, Jurisprudence, Philosophy, Archaeology, Comparative religion, Ethics, History, criticism and theory of the arts, Perforing Arts, Journalism, Psychology, Political science and such subject areas.

Theatre, music, dance, and other kinds of performances are present in all human cultures. The history of music and dance date back to pre-historic times. In India, religion, philosophy and myth cannot be divorced from their art forms. Dance, Drama and music are tied inextricably to ceremony of any kind. Bharatnatyam, Kathakali, Kathak, Manipuri, Odissi, Kuchipudi, Sattriya, Mohiniyattam are some of the classical Dance forms of India. Similarly, the classical music forms of India are Hindustani Classical Music and Carnatic Classical Music, in addition, there are hundreds of regional music forms and there are many musical instruments to compose and play music. Koodiyattam, Yakshagana, Swang, Bhand Paather, Ankiya Naat Bhaona, Tamasha, Therukoothu, Jatra are some of theatre forms of India. In addition, there are puppet forms. They all adhere to the canons of classical dance laid down in the Natya Shastra, a second century C.E. text ascribed to the sage Bharata, to whom it was supposedly revealed by the Creator, Brahma.

Performing arts in India and its practitioners are referred to as being part of the “entertainment industry.” This indicates a paradigm shift in the manner in which the arts is being viewed by society. The message apparent by the shift is that the audience now expects that the Arts must entertain in the manner defined by the entertainment industry, and they must form part of an organized industry. The performing arts industry in India reached INR236 billion in 2012 and is expected to witness a CAGR of 2.5% over 2012—2018 to reach INR275 billion in 2018. The industry will primarily be driven by new and innovative forms of fund raising by theater and dance groups and a growing demand for Indian culture at an international level.

At present more than 400 million youth are below 18 years of age and they have varied aspirations. A significant number of them would like to work in entertainment industry.

In this context, a Post Graduate Program in Performing Arts offered by **REVA UNIVERSITY** is relevant to meet the future human resources requirement of Entertainment Industry and also safe guard Indian tradition and culture.

Programme Educational Objectives (PEOs)

This Post- Graduate programme of 4 semesters in Performing Arts is to ensure that the student learns the subject of ance, music and other forms of performing arts in their specialized field both theoretically and practically. It is to ensure the overall holistic development of the dancer and performer. Being a dancer in today's competitive World is not travelling around and performing, but also about the communication skills that are required and the technical knowledge in their respective subject that one must possess to make them stand out in the crowd. This programme would instill in them an enthusiasm to teach the subject, ensure that they become professional performers, and trigger in them the inquisitiveness to be Research Scholars for their Doctoral Thesis in the future

The Programme Educational Objectives are to prepare the students to:

1. Perform as Dancers/Musicians/Actors in entertainment sector
2. Work as creative directors, choreographers, producers of art and entertainment programmes
3. To work as managers, academicians, administrator or entrepreneurs with strong ethics and communication skills
4. Pursue higher education and research in reputed institutes at national and international level
5. Aware of environmental, legal Issues, cultural and constitutional obligations
6. Adopt lifelong learning for continuous improvement

Programme Outcomes (POs)

This MPA programme ensures the students to gain knowledge both in the theory and the practical aspects of Indian Classical Dance of their specialization. The courses and the examinations in each semester make them well equipped to take Dance at the Research level for their Doctoral pursuance in future.

After undergoing this programme, a student will be able to:

1. Perform as an artist, particularly as a Dancer
2. Act as a Choreographer
3. Write drama and act
4. Use modern technologies for enhancing the performance of entertainment industry
5. Direct and produce relevant products for entertainment industry
6. be qualified Teachers and Practitioners in the chosen field of dance
7. Choose appropriate online programmes for further learning, participate in seminars and conferences
8. Manage information, develop technical reports and make presentations

9. Lead a team to successfully complete a project and communicate across teams and set up his/her own enterprise
10. Conduct himself / herself as a responsible citizen

Programme Objective:

This Post- Graduate programme of 4 semesters in Fine Arts is to ensure that the student learns the subject of Dance in their specialized field both theoretically and practically. It is to ensure the overall holistic development of the Dancer. Being a dancer in today's competitive World is not travelling around and performing, but also about the communication Skills that are required and the Technical knowledge in their respective subject that one must possess to make them stand out in the crowd. This programme would instill in them an enthusiasm to teach the subject, ensure that they become professional performers, and trigger in them the inquisitiveness to be Research Scholars for their Doctoral Thesis in the future.

Programme Outcome:

This MFA programme ensures the students to gain knowledge both in the theory and the practical aspects of Indian Classical Dance of their specialization. The courses and the examinations in each semester make them well equipped to take Dance at the Research level for their Doctoral pursuance in future. It enables them to be qualified Teachers and Practitioners in their chosen field of Dance.

REVA UNIVERSITY
Bengaluru, India

MASTER OF FINE ARTS
(Bharatanatyam)

Scheme of Instruction for Academic Year 2017-19

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Credit Value			No. of Hrs.	
				L	T	P	Total	Sessions
FIRST SEMESTER								
1	MFBN17F1100	Dance History	HC	4	0	0	4	4
2.	MFBN17F1200	English and Communications - I	HC	3	0	0	3	3
3.	MFBN17F1300	Fundamentals (Adavus, Alaripu, Jatiswaram) - Practical 1	HC	0	0	4	4	6
4.	MFBN17F1400	Items (Shabdam, Kriti) – Practical 2	HC	0	0	4	4	6
5.	MFBN17F1500	Slokas (Natya Sastram) – Practical 3	HC	4	0	0	4	4
6.	MFBN17F1600	Music Paper - 1 (Theory and practical)	HC	1	0	2	3	4
7.	MFBN17F1700	Kannada		2	0	0	2	2
		Total Credits					24	29
SECOND SEMESTER								
1	MFBN17F2100	Art History and Choreography	HC	4	0	0	4	4
2	MFBN17F2200	English and Communications II	HC	3	0	0	3	3
3	MFBN17F2300	Items (Varnam- Pada or Tana, Thillana) - Practical 1	HC	0	0	4	4	6
4	MFBN17F2400	Items (Javali, Padam) - Practical 2	HC	0	0	4	4	6
5	MFBN17F2500	Slokas (Abhinaya Darpanam) - Practical 3	HC	1	0	3	4	6
6	MFBN17F2600	Music Paper - 2 (Theory and Practical)	HC	1	0	2	3	4
7	MFBN17F2700	Sanskrit	HC	2	0	0	2	2
		Total Credits					24	29

THIRD SEMESTER									
1	MFBN17F3100	Aesthetics in Dance	HC	3	0	0	3	3
2	MFBN17F3200	Research Methodology	HC	3	0	0	3	3
3	MFBN17F3300	Arts Management	HC	3	0	0	3	3
4	MFBN17F3400	Items (Varnam – Daru or Swarajathi) - Practical 1	HC	0	0	3	3	5
5	MFBN17F3500	Individual Choreography - Practical 2	HC	0	0	3	3	5
6	MFBN17F3600	Slokas (Natya Sastra and Abhinaya Darpanam) - Practical 3	HC	1	0	2	3	4
7	MFBN17F3700	Telugu	HC	2	0	0	2	2
8	MFBN17F3830	Folk Dance	OE	2	0	2	4	5
9	MFBN17F3840	Classical Dance	OE					
		Total Credits					24	30
FOURTH SEMESTER									
1	MFBN17F4100	Dance Writing and Biographies	HC	3	0	0	3	3
2	MFBN17F4200	Ashta Nayikas - Practical 1	HC	1	0	2	3	4
3	MFBN17F4300	Navarasas - Practical 2	HC	1	0	2	3	4
4	MFBN17F4400	Nattuvangam - Practical 3	HC	1	0	2	3	4
5	MFBN17F4500	Group Choreography	HC	0	0	4	4	6
6	MFBN17F4600	Field Trip & Dissertation	HC	0	0	8	8	-
		Total Credits					**24**	21
		Total Credits of Four Semesters					**96**	

Detailed Syllabus

(Effective from Academic Year 2017-18)

SEMESTER-I

Course Code	Duration	Course Title		L	T	P	C
MFA17F1100	16 Weeks	DANCE HISTORY	HC	4	0	0	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the History and the Development of Dance from a bird's eye view.
- To inculcate the habit of reading and writing Dance and Art Papers, Journals, Blogs, Articles and Reviews for their academic betterment.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World the History and the aspects of the Dance.
- To be able to write Research papers in their chosen field of Dance with a strong base of history knowledge that helps them to analyze the great and rich cultural and dance heritage of our country.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Evolution of Dance	1. Definitions of Dance 2. Dance in Stone, Bronze and Iron Age periods 3. Dances in Vedic period 4. Dance in today's scenario
2	Natya Sastra, & Tandava, Lasya, and Dasaroopakas: Introduction	1. Natya Sastra -11 Aspects: Origin of Natyaveda and Natya Sastra, Rasa, Bhava , Abhinaya, Dharmi, Vritti, Pravritti, Siddhi, Swara, Atodyam, Ganam, Rangam, Margi and Desi 2. Tandava - 7 types 3. Lasya - Types Each aspect of the above applying to dance drama in detail 4. Dasaroopakas

3	Contribution of Dynasties and Sources of Dance	1. Primary Sources: Literary, Inscriptional, Monumental, Architectural, Archaeological, Paintings, and manuscripts 2. Secondary sources 3. Dynasty origin and reigns: Genealogy, Key Emperors, Patronage to art, Trade and socio economic strategies, Downfall, Architectures of the dynasties
4	Sculpture and Iconography	1. Definitions 2. Iconography in India 3. Buddist iconography 4. Jain iconography 5. Shaiva iconography 6. Vaishnava Iconography 7. Shakti Iconography

Course Code	Duration	Course Title		L	T	P	C
MFA17F1200	16 Weeks	ENGLISH AND COMMUNICATIONS - 1	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts develop their basic communication skills in English.
- To inculcate the habit of reading and writing Dance and Art Papers, Journals, Blogs, Articles and Reviews for their academic betterment.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with one or many listeners using the appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas, logically on the topic.

Course Contents:

UNIT	Description	Topics
1	Communication Skills and Functional English	1. Basics of Communication 2. Verbal and Non – Verbal Communication 3. Barriers of effective communication 4. Tenses 5. Conditional Statements 6. Auxiliaries (Modal and Primary)
2	Listening and Reading Skills	1. Definitions (Listening and Reading) 2. Types of Listening 3. Barriers to effective listening 4. Types of Reading 5. Techniques of Effective Reading 6. Reading Tasks (Critical and Inferential)
3	Academic Writing – 1	1. Paragraphs 2. Summarizing 3. Project Reports
4	Skills – 1	1. Emails 2. Article/Review/ Research paper 3. Mail etiquette 4. Applying for grants/programmes

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Fundamentals	1. Basic exercises in standing, sitting, running, stretching and sleeping postures 2. 1st half steps in Chaturasra Jaathi 3. 2nd half steps in Tisra, Chaturasra, Khanda, Mishra and Sankeerna Jaathis

2	Jathis	4. 12 jathis in Chaturasra jaathi 5. Recitation of the steps and Jathis with Thaalam and nattuvangam
3	Items – 1	6. Jathiswaram - 1
4	Items - 2	7. Kouthvam - 1

Course Code	Duration	Course Title		L	T	P	C
MFA17F1320	16 Weeks	**FUNDAMENTALS – BHARATANATYAM (Adavus, Alaripu, Jatiswaram) – PRACTICAL -** 1	SC	0	0	4	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Fundamentals	1. Basic exercises in standing, sitting, running, stretching and sleeping postures 2. Taddadavu 3. Natadavu 4. Paraval Adavu 5. Kudduthu mettadavu 6. Mettadavu 7. Mandi adavu 8. Teerumana Adavu 9. Tataitham adavu 10. Kathi adavu
2	Jathis	11. Jathis in all Jaathis 12. Recitation of the steps and Jathis with Thaalam and nattuvangam

3	Items – 1	13. Alaripu - 1
4	Items - 2	14. Jathiswaram - 1

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Items – 1	1. Poorvarangam – 1
2	Items – 1	2. Shabdam – 1
3	Items – 1	3. Annamacharya/ Ramadasa keertana – 1
4	Nattuvangam	4. Nattuvangam for the items learned in the respective semester

Course Code	Duration	Course Title		L	T	P	C
MFA17F1420	16 Weeks	ITEMS - Bharathanatyam (Shabdam, Kriti) – Practical - 2	SC	0	0	4	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Items – 1	1. Shabdam – 1
2	Items – 2	2. Kriti – Anupallavi, Pallavi
3	Items –3	3. Kriti – Charanam
4	Nattuvangam	5. Nattuvangam for the items learned in the respective semester

Course Code	Duration	Course Title		L	T	P	C
MFA17F1500	16 Weeks	SLOKAS (NATYA SASTRAM) PRACTICAL - 2	HC	4	0	0	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the shloka aspects from the textual traditions in Dance in both the practical and the theory concepts.
- To teach students the depth of the technicalities in dance through varied dance scriptures and make them adept in the recitation of the shlokas.

Course Outcomes:

On completion of the course learners will be able to:

- Recite the shlokas of all the technicalities of dance.
- To be able to enact the shlokas through the body movements for better understanding.

Course Contents:

UNIT	Description	Topics
1	Natyarambha Shloka and Paada bhedas	1. Natyarambha Shlokam 2. 6 types of Paada Bhedas
2	Hasta Bhedas	3. Asamyuta Hastas 4. Samyuta Hastas
3	Nritta Hastas	5. Nritta Hastas
4	Bhedas	6. Shiro 7. Greeva 8. Drishti 9. Urah 10. Parshva 11. Kati

Course Code	Duration	Course Title		L	T	P	C
MFA17F1600	16 Weeks	MUSIC – 1 (Theory & Practical)	HC	1	0	2	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the music aspects from the textual traditions in Dance in both the practical and the theory concepts.
- To teach students the depth of the technicalities in music through varied music scriptures and make them adept in the recitation of the songs in the Carnatic style of music.

Course Outcomes:

On completion of the course learners will be able to:

- Sing the technical aspects of Carnatic Music.
- Will be able to sing the songs that are taught as items in the practical papers of the respective semesters.

Course Contents:

UNIT	Description	Topics
1	Fundamentals – 1	1. Sarali Varasagalu 2. Janti Varasagalu
2	Fundamentals – 2	3. Madhyasthyi varasagalu 4. Alamkaragalu
3	Fundamentals – 3	5. Swarapallavi

4	Nattuvangam and tattukazhi	6. Learn to play Nattuvangam and Tattukazhi required for Dance

Course Code	Duration	Course Title		L	T	P	C
MFA17F1700	16 Weeks	KANNADA	HC	2	0	0	2

Course Objectives:

- To enable the dancers/artist of School of Performing Arts develop their basic communication skills in Kannada.
- To inculcate the habit of reading and writing Kannada which is the State language of Karnataka.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with one or many listeners using Kannada language.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas, logically on the topic.

Course Contents:

UNIT	Description	Topics
1	Fundamentals – 1	1. Kannada varnamale 2. Swara Vyanjana
2	Fundamentals – 2	3. Ottakshara 4. Gunintakshara
3	Word and Sentence formations	5. 2,3,4 lettered word formations 6. Simple sentence formations
4	General Knowledge	Prominent names, Places and Current Affairs

SEMESTER-II

Course Code	Duration	Course Title		L	T	P	C
MFA17F2100	16 Weeks	ART HISTORY OF CHOREOGRAPHY	HC	4	0	0	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the History and the Development of Dance and it's choreography in a detailed way.
- To be able to choreograph their own items including the right amount of technicalities and understanding them from the Sastra point of view.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World the History and the aspects of the Dance and its choreographic techniques.
- To be able to choreograph their own items including the right amount of technicalities and understanding them from the Sastra point of view.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Evolution of Choreography	1. Definition of Choreography 2. History of Choreography 3. Principles and Objectives of Choreography 4. Bandhas in Natya Sastra
2	Subjects of Choreography	5. Selection of Subjects 6. Musical Treatment of Subjects 7. Past, present and future of Choreography
3	Dance Dramas and Film Choreography	8. Choreography in Indian Films 9. Choreography in Classical based films 10. Dance drama Traditions of India.

4	Biographies	11. Biographies of famous Choreographers 12. Vedic period to modern age choreography
		13.

Course Code	Duration	Course Title		L	T	P	C
MFA17F2200	16 Weeks	ENGLISH AND COMMUNICATIONS-II	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts develop their basic communication skills in English.
- To inculcate the habit of reading and writing Dance and Art Papers, Journals, Blogs, Articles and Reviews for their academic betterment.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with one or many listeners using the appropriate communicative strategies.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas, logically on the topic.

Course Contents:

Unit	**Description**	**Topics**
1	Language in Use	1. Vocabulary Building 2. Functional Words 3. Idioms and Phrasal verbs 4. Homonyms and Homophones
2	Employability Skills	1. CV and Resume Preparation 2. Body language and gestures 3. Attitude and behaviour 4. Group Discussions 5. Presentation Skills

3	Academic Writing – 2	1. Essays 2. Letter Writing 3. Proposals
4	Personality Development Skills – 2	1. Personality Development 2. On and off stage presentation skills 3. Public Speaking Skills 4. Dining Etiquette

Course Code	Duration	Course Title		L	T	P	C
MFA17F2320	16 Weeks	ITEMS -BHARATHANATYAM (Varnam- Pada or Tana, Thillana) - PRACTICAL - 2	HC	0	0	4	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Items – 2	1. Varnam – half
2	Items – 2	2. Varnam – other half
3	Items – 2	1. Thillana - 1
4	Nattuvangam	2. Nattuvangam for all the jathis and items learned in the semester

Course Code	Duration	Course Title		L	T	P	C
MFA17F2420	16 Weeks	ITEMS - BHARATHANATYAM (Ashtapadi, Javali, Padam) PRACTICAL-2	HC	0	0	4	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Items – 1	1. Ashtapadi – 1
2	Items – 2	2. Javali – 1
3	Items – 3	3. Padam – 1
4	Nattuvangam	4. Nattuvangam for the items learned in the respective semester

Course Code	**Duration**	**Course Title**		**L**	**T**	**P**	**C**
MFA17F2500	16 Weeks	SHLOKAS (Abhinaya Darpanam)	HC	4	0	0	4

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the shloka aspects from the textual traditions in Dance in both the practical and the theory concepts.
- To teach students the depth of the technicalities in dance through varied dance scriptures and make them adept in the recitation of the shlokas.

Course Outcomes:

On completion of the course learners will be able to:

- Recite the shlokas of all the technicalities of dance.
- To be able to enact the shlokas through the body movements for better understanding.

Course Contents:

UNIT	Description	Topics
1	Hasta Bhedas	1. Asamyuta Hastas 2. Samyuta Hastas
2	Viniyogas	3. Hasta viniyogas
3	Paada Bhedas	4. Paada Bhedas
4	Different Hasta Bhedas	5. Dasavatara 6. Devatha 7. Chaturvarna 8. Navagraha

Course Code	Duration	Course Title		L	T	P	C
MFA17F2600	16 Weeks	MUSIC-2 (Theory and Practical)	HC	1	0	2	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the music aspects from the textual traditions in Dance in both the practical and the theory concepts.
- To teach students the depth of the technicalities in music through varied music scriptures and make them adept in the recitation of the songs in the Carnatic style of music.

Course Outcomes:

On completion of the course learners will be able to:

- Sing the technical aspects of Carnatic Music.
- Will be able to sing the songs that are taught as items in the practical papers of the respective semesters.

Course Contents:

UNIT	Description	Topics
1	Fundamentals – 2	1. Geetham and Varnam
2	Fundamentals – 2	2. Jathi Sollu 3. Jaathi Sollu

3	Fundamentals – 2	4. Yathis
4	Own Composition	5. Should be able to construct Jathis of their own and also notate them

Course Code	**Duration**	**Course Title**		**L**	**T**	**P**	**C**
MFA17F2700	16 Weeks	SANSKRIT	HC	2	0	0	2

Course Objectives:

- To enable the dancers/artist of School of Performing Arts develop their basic understanding skills in Sanskrit.
- To inculcate the habit of reading and writing Sanskrit that would be helpful for their dance presentations and choreographies.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with one or many listeners using Kannada language.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas, logically on the topic.

Course Contents:

UNIT	**Description**	**Topics**
1	Introduction	1. Sanskrit as language 2. Akshara mala 3. Transliteration
2	Fundamentals	4. Guninta Akshara 5. Samyukta akshara 6. Numbers from 1 to 100
3	Vyakarana	7. Grammar with Verbs or Dhatus 8. Shabdas for all genders ending with a , e , u
4	General Knowledge	Prominent names, Places and Current Affairs

SEMESTER-III

Course Code	**Duration**	**Course Title**		**L**	**T**	**P**	**C**
MFA17F3100	16 Weeks	AESTHETICS IN DANCE	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the History and the Development of Dance and its aesthetics.
- To be able to choreograph their own items including the right amount of technicalities and understanding them from the Sastra point of view.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World the History and the aspects of the Dance and its aesthetics..
- To be able to read research materials and write their research papers from the vast amount of Cultural knowledge that is available.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Rasa Theory - 1	1. Bharata's Rasa Theory
2	Rasa Theory – 2	2. Abhinava Gupta's Rasa theory 3. Bhoja's Rasa Theory
3	Sanchari	4. Concept of Sanchari related to Dance
4	Philosophy and Spirituality	5. Hinduism and its relationship to Dance 6. Spiritual aspects of dance and other arts.

Course Code	Duration	Course Title		L	T	P	C
MFA17F3200	16 Weeks	RESEARCH METHODOLOGY	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the Research and its allied aspects related to Dance.
- To be able to deliver the theoretical aspects of Research that would help them in their Doctoral Thesis in future.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World the Research aspects of dance.

- To be able to read research materials and write their research papers from the vast amount of Cultural knowledge that is available.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Research Methodology: Foundations and Sources of data	1. Definitions 2. Literature Review 3. Primary Sources 4. Secondary Sources
2	Research Process	5. Selection of Subjects 6. Preparation of Synopsis 7. Research Work
3	Data Collection	8. Data Collection Methods - Observation - Experimentation - Survey 9. Tools for Data Collection - Questionnaire - Interview 10. Field Work 11. Data Processing and Analysis
4	Report Writing and Bibliography	12. Planning Report writing 13. Research Report Format 14. Organisation of Report and Report Writing 15. Footnotes and Bibliography - Reference Books and Journals - Supportive Materials - Audio Visual equipment - E-resources

Course Code	Duration	Course Title		L	T	P	C
MFA17F3300	16 Weeks	ARTS MANAGEMENT	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the management and its allied aspects related to Dance.

- To be able to deliver the theoretical aspects of Marketing and Branding that would help them to emerge as holistic artists.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World about themselves.
- To be able to apply for programmes, grants, scholarships and all the allied aspects related to dance and giving hands on experience.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Arts Administration	1. Arts Administration 2. Audience development 3. Programme Planning
2	Budget Management	4. Budget Management 5. Fund Raising 6. Grantsmanship in Arts
3	Legal Aspects and Marketing	7. Arts Administration 8. Policies and Legal Aspects 9. Marketing Concepts 10. Advertisements and Public Relations
4	Dance Company Management	11. Dance Company Management in India 12. Dance Company Management abroad

Course Code	Duration	Course Title		L	T	P	C
MFA17F3420	16 Weeks	ITEMS – BHARATHANATYAM (Varnam – Daru or Swarajathi Varnam) – PRACTICAL	HC	0	0	3	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Items – 1	1. Varnam – 1/3
2	Items – 2	2. Varnam – 2/3
3	Items – 3	3. Varnam – 3/3
4	Nattuvangam	4. To do Nattuvangam for the item learned

Course Code	Duration	Course Title		L	T	P	C
MFA17F3500	16 Weeks	INDIVIDUAL CHOREOGRAPHY PRACTICAL-2	HC	0	0	3	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Selection	1. Selection of theme 2. Analysis and report

2	Music	3. Music for the theme 4. Choreography
3	Costumes and properties	5. Selection of costumes 6. Selection of Properties
4	Recitation	7. Recitation and Presentation

Course Code	Duration	Course Title		L	T	P	C
MFA17F3600	16 Weeks	SLOKAS (Natya Sastra and Abhinaya Darpanam) – THEORY AND PRACTICAL	HC	1	0	2	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the shloka aspects from the textual traditions in Dance in both the practical and the theory concepts.
- To teach students the depth of the technicalities in dance through varied dance scriptures and make them adept in the recitation of the shlokas.

Course Outcomes:

On completion of the course learners will be able to:

- Recite the shlokas of all the technicalities of dance.
- To be able to enact the shlokas through the body movements for better understanding.

Course Contents:

UNIT	Description	Topics
1	Chari	1. Bhoumi Charis 2. Akasiki Charis
2	Mandala	3. Mandala Bhedas
3	Abhinaya	4. Mukhaja
4	Bhedas	5. Bhru 6. Drishti 7. Puta 8. Kapola 9. Adhara 10. Greeva

Course Code	Duration	Course Title		L	T	P	C
MFA17F3700	16 Weeks	TELUGU	HC	2	0	0	2

Course Objectives:

- To enable the dancers/artist of School of Performing Arts develop their basic understanding skills in Telugu.

- To inculcate the habit of reading and writing Telugu that would be helpful for their dance presentations and choreographies.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with one or many listeners using Telugu language.
- Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas, logically on the topic.

Course Contents:

UNIT	Description	Topics
1	Introduction	1. Telugu as language 2. Akshara mala
2	Fundamentals	3. Guninta Akshara 4. Vothulu 5. Numbers from 1 to 100
3	2, 3, 4 lettered words	6. 2, 3, 4 lettered words
4	General Knowledge	Prominent names, Places and Current Affairs

Course Code	Duration	Course Title		L	T	P	C
MFA17F3810	16 Weeks	CLASSICAL DANCE	OE	2	0	2	4

Course Code	**Duration**	**Course Title**		**L**	**T**	**P**	**C**
MFA17F3820	16 Weeks	MRUDANGAM	OE	2	0	2	4

Course Code	Duration	Course Title		L	T	P	C
MFA17F3830	16 Weeks	DRAMATICS	OE	2	0	2	4

SEMESTER-IV

Course Code	Duration	Course Title		L	T	P	C
MFA17F4100	16 Weeks	DANCE WRITING AND BIOGRAPHIES	HC	3	0	0	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts to gain knowledge in the History and the Development of Dance and it's legends in a detailed way.
- To be able to choreograph their own items including the right amount of technicalities and understanding them from the Sastra point of view.

Course Outcomes:

On completion of the course learners will be able to:

- Speak clearly, confidently, comprehensibly and communicate with the World the History and the aspects of the Dance and its legends.
- To be able to write and understand about the legendary personalities and their works.

Course Contents:

UNIT	DESCRIPTION	TOPICS
1	Dance Criticism	1. Criticism 2. News paper articles
2	Essay writing	3. Theoretical writing 4. Essay writing
3	Western ballet	5. Origin of western ballet 6. Development of western ballet 7. South Indian dance Dramas
4	Biographies	8. Biographies of legendary Gurus and Performers

Course Code	Duration	Course Title		L	T	P	C
MFA17F4200	16 Weeks	ASHTA NAYIKAS PRACTICAL - 1	HC	1	0	2	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing.
- To teach students the items in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned.
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Nayikas	1. Study of Nayikas
2	Nayakas	2. Study of Nayakas
3	Rasa	3. Concept of rasa in Nayikas and nayakas
4	Choreography	4. Choreographing each Rasa with a concept and analysis.

Course Code	Duration	Course Title		L	T	P	C
MFA17F4300	16 Weeks	NAVARASAS PRACTICAL - 2	HC	1	0	2	3

Course Objectives:

- To enable the dancers/artist of School of Performing Arts have a strong foundation in the basics and fundamentals in the practical and performing aspects of the dance form that they are specializing and Nattuvangam.

- To teach students the Nattuvangam in dance and also the technical aspects of the items which include taalam, music, literature and the spiritual and philosophical depths in it.

Course Outcomes:

On completion of the course learners will be able to:

- Perform the fundamentals and the items that they have learned with Nattuvangam
- Will be able to further teach the items and also understand the intricacies in choreographing such items in future.

Course Contents:

UNIT	Description	Topics
1	Concept of Nattuvangam	1. Understanding the concept of Nattuvangam
2	Jaathi	2. Jaathi 3. Jathi 4. Korvai
3	Taalam	5. System of taalam
4	Own Choreography	6. Creating own jathis and performing

Course Code	Duration	Course Title		L	T	P	C
MFA17F4400	16 Weeks	NATTUVANGAM PRACTICAL - 3	HC	1	0	2	3

Course Code	Duration	Course Title		L	T	P	C
MFA17F4500	16 Weeks	GROUP CHOREOGRAPHY	HC	0	0	4	4

Course Code	Duration	Course Title		L	T	P	C
MFA17F4600	16 Weeks	FIELD TRIP & DISSERTTION	HC	0	0	8	8

CAREER DEVELOPMENT AND PLACEMENT

Having a degree will open doors to the world of opportunities for you. But Employers are looking for much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

1. Willingness to learn
2. Self motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of performing arts is knowledge in the subject, but also the skill to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Performing Arts also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The University has also signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

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