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.

**E**very 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<br>Director & Professor, REVA University<br>EEE Department<br>rajashekarpm@reva.edu.in & Ph: 9448465065 | Chairperson |
| 2 | Dr. Divakar B P<br>Professor<br>Director R&D<br>REVA University<br>divakar@reva.edu.in & Ph:9482009544 | Member |
| 3 | Dr. Ravishankar Deekshith<br>Prof & HOD<br>Electrical Engineering Department<br>BMCE, Bull Temple Road | Member |
| 4 | Dr. Ravikumar<br>Prof & HOD<br>Electrical Engineering Department, NMIT, BANGALORE<br>hmrgama@gmail.com & Ph: 8105561726 | Member |
| 5 | Dr. Narendranath Udupa<br>Principal Scientist<br>Philips Research ASIA<br>Manayatha Tech Park Bangalore<br>narendranath.udupa@philips.com & Ph: 9845292110 | Member |
| 6 | Mr. Paramesha. K<br>Deputy Director (Power System)<br>Karnataka Electricity Regulatory Commission<br>No. 9/2, 6th Floor, Mahalakshmi Chambers<br>M.G. Road Bengaluru -56 00 01.<br>kparamesha@gmail.com & Ph: 9448235019 | Member |
| 8 | Mr. K. Narayana Swamy<br>Professor, REVA ITM<br>EEE Department<br>kns@revainstitution.org & Ph: 9448736750 | Member |
| 9 | Dr. Vishu Kumar<br>Assoc. Professor<br>Department of Basic Science, Mathematics<br>REVA ITM<br>vishukumar@revainstitution.org & Ph: 9845871372 | Member |
| 10 | Mr. Gopinath<br>Assoc. Professor<br>EEE DEPARTMENT<br>REVA ITM<br>gopinath@revainstitution.org & Ph: 9449668379 | Member |
| 13 | Mr. Mahesh G.S.<br>Asst. Professor<br>School of Electrical & Electronics Engg. REVA University, Bangalore | Member |

## ADVISORY BOARD

| Sl. No. | Name of Members |
|---|---|
| 1 | Dr Adrian Inoinovici,<br>Fellow IEEE, Director, Power Electronics and Green Energy Centre, Sun-Yat-Sen University, China.<br>adrian@hit.ac.il |
| 2 | Dr Danny Sutanto,<br>Professor of Power Engineering, School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, Australia.<br>soetanto@uow.edu.au |
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| 5 | Dr. Z. H. Sholapurwala<br>Managing Director<br>Zeonics Systech Defence & Aerospace Engineers Pvt. Ltd.<br>zeonicssystech@india.com |
| 6 | K N Singh<br>Manager-Marketing - Special Applications<br>EFD Induction Private Limited<br>Mob: +91 98456 05871<br>skn@efdgroup.net |

## 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 $5^{th}$ Semester and in 1 course of $6^{th}$ Semester. He / She has also passed all the courses of First to Fourth Semesters. Student "D" is also eligible to seek admission for $7^{th}$ Semester and appear for C3 examination of 3 failed courses of $5^{th}$ Semester concurrently with $7^{th}$ Semester C3 examination and one failed course of $6^{th}$ Semester concurrently with $8^{th}$ 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<br>P | Grade<br>G | Grade Point<br>(GP=V x G) | Letter<br>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) | 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 | 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.

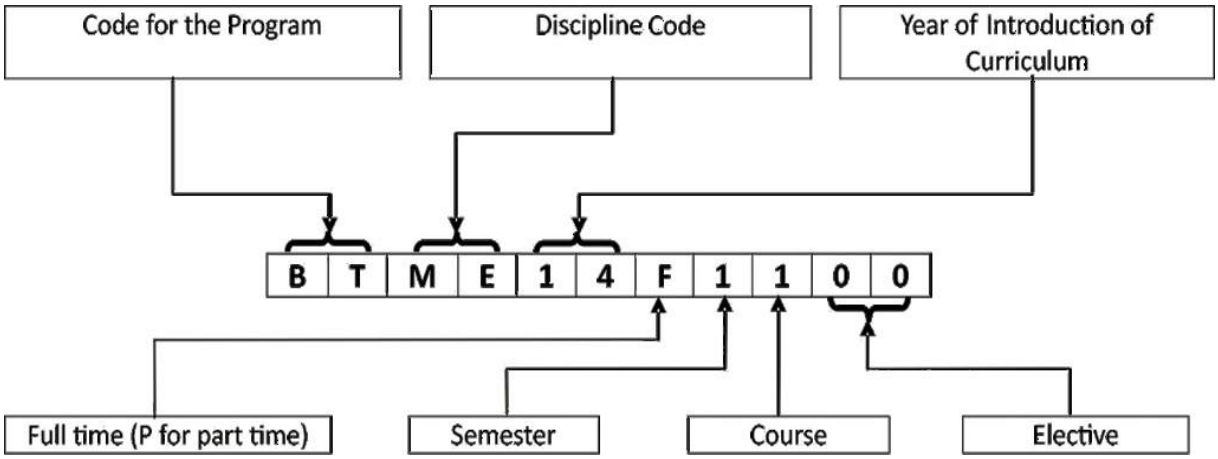
The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs.

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

| Sub Code: BTEM15F1100 | Engineering Mathematics – I | C | L | T | P | CH |
|---|---|---|---|---|---|---|
| Duration : 14 Wks | | 4 | 3 | 1 | 0 | 5 |
| **Prerequisites:** | Knowledge of basics limits, continuity, differentiation, integration, matrices, determinants, and geometry. | | | | | |
| **Course Objectives** | 1. To understand the concepts of differential calculus and its applications.<br>2. To familiarize with partial differentiation and its applications in various fields.<br>3. To familiarize with linear algebraic applications and different reduction techniques.<br>4. To familiarize with concept of vector calculus and its applications. | | | | | |
| **Course Outcomes** | After the completion of the course the student will be able to:<br>1. Apply the knowledge of differential calculus in the field of wave theory and communication systems.<br>2. Apply the knowledge of Differential Equations in the field of Engineering.<br>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.<br>4. Apply the knowledge of convergence of the series, which help in forming JPEG image compression.<br>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. | | | | | |

## 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 2nd 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.

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

## 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 ($\chi$,), dielectric constant, relation between $\chi$ 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.<br>2. To enable students to understand the basics of composition of coplanar forces.<br>3. To enable students to understand the concept of equilibrium of coplanar forces.<br>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:<br>1. Describe the moment of force and couples and equivalent force-couple system.<br>2. Solve numerical problems on composition of coplanar concurrent and non-concurrent force system.<br>3. Solve numerical problems on equilibrium of coplanar force system.<br>4. Locate the centroid and moment of inertia of different geometry. | | | | | |

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## 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.


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

## 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.<br>2. To make students understand the basics of representation of electrical quantities and relationship among them.<br>3. To provide an overview of various types of electrical apparatus.<br>4. To introduce the concept of domestic wiring and importance of safety and sensing devices.<br>5. To provide an insight into various sources of power generation. | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Describe the operation and control of various types of generation of electricity<br>2. Describe the principle of operation of electrical apparatus<br>3. Differentiate between single and three phase systems<br>4. Solve simple mathematical relationships related to electrical apparatus.<br>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.<br>2. To know and understand about the Fundamental Rights, Duties and other Rights which is been given by our law.<br>3. To prepare students in the practicality of Constitution perspective and make them face the world as a bonafide citizen.<br>4. To attain knowledge about ethics and also know about professional ethics.<br>5. Explore ethical standards followed by different companies. | | | | | |
| **Course Outcomes** | On completion of this course the student will be able to:<br>1. Strengthen the knowledge on Indian constitutional law and make the practical implementation of it.<br>2. Understand the fundamental rights and human rights.<br>3. Get the knowledge to explain the duties and more importantly practise it in a right way.<br>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.<br>5. Get exposed about professional ethics and know about etiquettes about it.<br>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.<br>3. To equip them with writing skills needed for academic as well as workplace context.<br>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:<br>1. Listen/view and comprehend different spoken discourses/excerpts in different accents.<br>2. Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.<br>3. Read different genres of texts adopting various reading strategies.<br>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**<br>Fill in the blanks/ MCQs/ Short Notes/ Descriptive Answers | 1. Basics of Communication<br>2. Verbal & Non-verbal Communication<br>3. Barriers to Effective Communication<br>4. Strategies of Effective Communication<br>5. Tenses<br>6. Conditional Sentences<br>7. Auxiliaries (Modal & Primary) | 16 Hours |
| II | Listening & Reading Skills | **25 Marks**<br>Short Notes/ Descriptive Answers/ Comprehension Tasks | 1. Definitions (Listening & Reading)<br>2. Types of Listening<br>3. Barriers to Effective Listening<br>4. Traits of a Good Listener<br>5. Types of Reading<br>6. Techniques of Effective Reading<br>7. Reading Tasks (Critical & Inferential) | 16 Hours |

| | | | | |
|---|---|---|---|---|
| III | Academic Writing – I | **25 Marks**<br>Short Notes/ Descriptive Answers | 1. Paragraphs<br>2. Notice/ Agenda/ Minutes<br>3. Note Taking/ Note Making<br>4. Summarizing<br>5. Project Reports | 16 Hours |
| IV | ICT/ Digital/ E-Skills | **25 Marks**<br>Short Notes/ Descriptive Answers | 1. Computer Assisted Language Learning (CALL)<br>2. Mobile Assisted Language Learning (MALL)<br>3. Emails<br>4. Blogs<br>5. Digital/ E-Portfolio<br>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.<br>2. To provide students with a theoretical and practical knowledge of Physics.<br>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.<br>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<br>1. Develop skills to apply practical knowledge of Physics in real time solution.<br>2. To understand and verify different laws of Physics using some simple experiments. | | | | | |

| | |
|---|---|
| | 3. To design simple electrical circuits and analyze obtained result.<br>4. Ability to apply knowledge of basic electronics in making simple circuits using diodes and transistors and analyze the responses.<br>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.<br>2. To provide hands on experience with electrical apparatus and electrical safety norms.<br>3. To train students to read and understand schematics so as to make | | | | | |

| | |
|---|---|
| | electrical connection for different appliances.<br>4. To train students in collecting and interpreting experimental data.<br>5. To enhance written skills of students. |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Use appropriate electrical tools for electrical connections and repair of electrical equipments.<br>2. Recognize various symbols in a schematic and make connection as per the schematic<br>3. Systematically follow various safety procedures.<br>4. Make use of various measuring instruments to collect experimental data<br>5. Relate experimental results with theoretical analysis.<br>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.<br>2. To understand the concepts of Integral calculus and its applications.<br>3. To familiarize with partial differential equations, and its applications to standard problems like Heat, Wave and Laplace.<br>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:<br>1. Apply the knowledge of Linear Algebra in Image processing and digital signal processing.<br>2. Apply the knowledge of Integral calculus to perform integration and other operations for certain types of functions and carry out the computation fluently.<br>3. Apply the knowledge of partial differential equations in the field of signals and systems, control systems, magnetic wave theory.<br>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(Ø*A*), curl(Ø*A*), curl(grad∅), 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.

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

## 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.


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

## 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.


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

## 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


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

## 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.<br>2. To develop the learners' competence in employability skills.<br>3. To inculcate the habit of writing leading to effective and efficient communication.<br>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:<br>1. Express their opinions clearly and meaningfully.<br>2. Face interviews confidently.<br>3. Write accurately using different components of academic writing.<br>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**<br>Fill in the blanks/ MCQs | 1. Vocabulary Building<br>2. Functional Words<br>3. Idioms & Phrasal Verbs<br>4. Homonyms & Homophones | 16 Hours |
| II | Employability Skills | **25 Marks**<br>Short Notes/ Descriptive Answers | 1. Job Applications<br>2. Curriculum Vitae<br>3. Group Discussions<br>4. Presentation Skills<br>5. Role Plays<br>6. Interview Skills<br>7. Debates | 16 Hours |
| III | Academic Writing | **25 Marks** | 1. Essays | 16 Hours |

| | | | | |
|---|---|---|---|---|
| | – II | Short Notes/ Descriptive Answers | 2. Letters<br>3. Dialogues<br>4. Proposals | |
| IV | Technical Speaking & Reading Skills | **25 Marks**<br>Short Notes/ Descriptive Answers | 1. Precis (Scientific Passages)<br>2. Public Speeches<br>3. Reading Manuals<br>4. Reading Scientific Reports<br>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).<br>2. Dimension and annotate two-dimensional engineering drawings.<br>3. Understand the application of industry standards and best practices applied in engineering graphics.<br>4. Emphasize freehand sketching to aid in the visualization process and to efficiently communicate ideas graphically.<br>5. Introduction of CAD software for the creation of 2D engineering drawings.<br>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.<br>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:<br>1. Develop independent thinking and problem solving capabilities.<br>2. Express component descriptions as per the commonly practiced standards.<br>3. Produce 2D and simple 3D drawings.<br>4. Comprehend industry specific drawings.<br>5. Converse through computer aided drawing any objects/tools/instruments/elements/ structures belonging to the entire engineering field.<br>6. Produce simple clear and illustrative drawings as per existing standards/conversations.</td></tr>
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# 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

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

# 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.

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

# 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<br>1. To understand the basics of numerical methods and their applications.<br>2. To solve the problems of Probability and statistics in various engineering fields.<br>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.<br>2. To illustrate the concept of network theorems<br>3. To describe the constituents of two port network.<br>4. To discuss the concept of resonance.<br>5. To adopt graph theory for network reduction and analysis | | | | | |
| **Course Outcomes** | After the completion of the course the student will be able to:<br>1. Reduce given three phase networks using star delta transformation<br>2. Solve typical network problems using standard network theorems<br>3. Represent the given network in terms of two-port network<br>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


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

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## 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.<br>2. To provide fundamental concepts about Power plant structure, operation and control.<br>3. To equip the students with basic concepts of Substations, Grounding systems and economic aspects.<br>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:<br>**1.** Compare the relative merits and limitations of available Energy Sources.<br>**2.** Interpret the values of various factors influencing the economic aspects of a power system<br>**3.** Recognize the role of Substation and the fundamentals of Grounding systems.<br>**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, 2nd 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.<br>2. To illustrate the necessary biasing techniques of transistors.<br>3. To familiarize students with transistor characteristics in Common Collector, Common Base and Common Emitter Mode.<br>4. To enable students with the concept of positive feedback applied in oscillators.<br>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:<br>1. Describe the operation, applicat ions and characteristics of devices including diodes and BJT.<br>2. Analyze and design circuits such as rectifiers, clippers, clampers, | | | | | |

| | |
|---|---|
| | amplifiers and oscillators.<br>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.<br>4. Apply the concepts of both positive and negative feedback in electronic circuits.<br>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.<br>2. Demonstrate the methods for simplifying Boolean expressions also familiarize the commonly used terms like minterm, canonical expression, SOP etc.<br>3. Introduce the Basic concepts of combinational and sequential logic.<br>4. Present real world examples for making the learners attuned to Logic concepts.<br>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:<br>1. Define a Boolean term, expression, SOP, POS, Minterm etc.<br>2. Construct the K-map from a Boolean expression and to find the minimal SOP/POS forms.<br>3. Determine the output and performance of given combinational and sequential circuits<br>4. Design arithmetic and combinational logic circuits using gates, encoders, decoders, multiplexers and de-multiplexers.<br>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

| **Sub Code:BTEE15F3700** | **Analog Electronic Circuit Design Laboratory** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration :14 Wks** | | **2** | **1** | **0** | **1** | **3** |
| **Course Objectives** | 1. To enable students to identify the various electronic components To enable students to verify theoretical analysis with experimental results.<br>2. To enable students to conduct experiments, collect results, interpret results and analyze any discrepancies | | | | | |
| **Course Outcomes** | Students will be able to<br>1. Rig circuit as per the circuit and conduct experiments.<br>2. Demonstrate the ability to design circuits for a given specification and to choose appropriate instruments for measurements.<br>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.<br>4. Analyze and design simple electronic circuits such as rectifiers, clippers, clampers, amplifiers and oscillators.<br>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.<br>6. Interpret the obtained experimental results<br>7. Present the results in a professional manner.<br>. | | | | | |

**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.

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

**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<br>1. To understand the basics of numerical methods and their applications.<br>2. To solve the problems of Probability and statistics in various engineering fields.<br>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 $2\pi$ 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.

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

## 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.<br>2. To discuss the concept of potential and energy density in the case of static and time varying fields.<br>3. To discuss the concepts of Coulomb's law and Gauss law and their applications.<br>4. To study the concept of the steady magnetic field, magnetic materials and inductance calculation.<br>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:<br>1. Able to understand the concepts of vector calculus and co-ordinate system.<br>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.<br>3. Able to understand the steady magnetic field, magnetic materials and inductance calculation<br>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 $\nabla$ 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, 7th edition, 2006

**Reference Books:**
1. John Krauss and Daniel A Fleisch, "Electromagnetics with Applications"**,** McGraw-Hill, 5th edition, 1999
2. Edward C. Jordan and Keith G Balmain, "Electromagnetic Waves And Radiating Systems," Prentice – Hall of India / Pearson Education, 2nd edition, 1968.Reprint 2002
3. David K Cheng, "Field and Wave Electromagnetics", Pearson Education Asia, 2nd 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<br>2. To enable to learn the necessity of different tests conducted and the parallel operation on single phase transformers<br>3. To enable to study the Classification and different connections of three phase Transformers<br>4. To enable to draw equivalent circuit & circle diagram for the | | | | | |

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|---|---|
| | performance Analysis of three phase induction motor.<br>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:<br>1. Reveal their knowledge and understanding of electromechanical energy conversion in Transformers and Induction machines.<br>2. Analyze the concepts of fundamental torque equation and rotating fields<br>3. Analyze the fundamental characteristics of Transformers and Induction machines.<br>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.<br>2. To discuss various computations and accessing methods associated with the microcontrollers.<br>3. To develop the skill of programming microcontrollers in controlling different applications in real time.<br>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:<br>1. To recognize the architecture of the 8051 and MSP430 microcontrollers.<br>2. To be adept at using various inbuilt features and external peripherals based on the requirement.<br>3. To program the microcontroller IC to suit the application and design simple electronic circuits which could be controlled using the microcontroller.<br>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.<br>2. To illustrate the students with the design concepts of Gate driver circuits, isolation and protection circuits of various power semiconductor devices.<br>3. To distinguish the Diode Rectifiers with Phase controlled Rectifiers for various loads.<br>4. To inculcate the skills of analyzing the basic topologies of DC-DC converters and AC voltage regulators for various loads.<br>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:<br>1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT and power MOSFETs.<br>2. Develop circuit models using electronic components such as resistors, capacitors, diodes and transistors.<br>3. Design the power semiconductor devices drive circuitry and driver ICs and heat sinks.<br>4. Analyze and design electronic circuits such as control rectifiers, inverters, choppers &AC voltage regulators.<br>5. Describe the role of Power Electronics as an enabling technologyin various applications such as flexible production systems, energy | | | | | |

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| | 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.<br>2. Understanding of various computations and accessing methods associated with the microcontrollers.<br>3. Gain the knowledge of programming.<br>4. Develop the ability to program the microcontroller in controlling the different applications in real time.<br>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:<br>1. Learn the architecture of the 8051, PIC and MSP430 microcontrollers.<br>2. Become adept at using various inbuilt features and external peripherals based on the requirement.<br>3. Design simple electronic circuits which could be controlledusing the microcontroller.<br>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.<br>2. To understand the operation, characteristics and performance parameters of controlled rectifiers.<br>3. To study the operation, switching techniques and basic topologies of DC-DC switching regulators.<br>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:<br>1. Acquire a basic knowledge of solid state electronics devices including power diodes, power BJT and power MOSFETs.<br>2. Develop circuit models using electronic components such as resistors, capacitors, diodes and transistors.<br>3. Analyze and design electronic circuits such as control rectifiers, inverters, choppers & ac voltage regulators.<br>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.<br>2. To provide adequate knowledge in the time response of systems and steady state error analysis, different types of controller.<br>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.<br>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:<br>1. Identity the applications of close loop and open loop systems and time variant and invariant systems.<br>2. Describe the controller application and time domain analysis.<br>3. Differentiate between time and frequency analysis and to determine stability by using different methods.<br>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.<br>2. Provide information of conductors & insulators which will be used for the transmission.<br>3. Provide information about the losses that occur during transmission and the ways of reducing the same.<br>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:<br>1. Understand the general layout of transmission and distribution of electrical system along with equipment.<br>2. Calculate and select the appropriate size of conductors and insulators for transmission & distribution system.<br>3. Compute the transmission and distribution losses and understand the various ways of reducing these losses.<br>4. Understand the different types of transmission and distribution systems with their merits and de-merits.<br>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,4th edition
2. S M Singh, 'Electric Power Generation Transmission & Distribution, PHI, 2nd 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.<br>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<br>3. Development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.<br>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:<br>1. Understand general signals and system properties and linear and time-invariant systems<br>2. Understand convolution sum and integral<br>3. Understand time and frequency domain representation of linear signals and systems<br>4. Perform Discrete-time (DT) and Continuous-time (CT) Fourier Transforms<br>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<br>2. To have good understanding of physical concepts and | | | | | |

| | |
|---|---|
| | operational features of DC and synchronous machines.<br>3. To equip the students with basic experimental skills for handling problems associated with electrical machines<br>4. To provide basis for further study of electrical machines |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Reveal their knowledge and understanding of electromechanical energy conversion in DC and synchronous machines<br>2. Analyze the concepts of fundamental torque equation and rotating fields<br>3. Analyze the fundamental characteristics of DC and synchronous machines<br>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.<br>2. To give an insight into various industrial applications of electricity | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Be able to think innovatively for other ways of producing electricity.<br>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', 12th 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<br>2. To Develop mathematical models of a drive (DC) system.<br>3. To understand the control aspects of electrical drives | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Describe the structure of a drive system and their role in any application.<br>2. Develop mathematical models using transfer functions for a DC motor<br>3. Analyze the given specifications and suggest a suitable motor for a particular application (like elevator system, escalator system, electric vehicle)<br>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.<br>2. To demonstrate an understanding of data flow descriptions.<br>3. To implement combinational and sequential circuits using | | | | | |

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|---|---|
| | VHDL.<br>4. To implement various digital circuits using Programmable Logic Devices.<br>5. Design of State Machines |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Compare Verilog HDL and VHDL.<br>2. Design simple logic circuits using data flow, structural and behavioral modelling concepts.<br>3. Implement combinational and sequential circuits.<br>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.<br>2. Give knowledge about network topologies and Ethernet standards<br>3. Explain various media access techniques, error detection and correction mechanisms<br>4. Familiarize the students with routing and error reporting protocols<br>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:<br>1. Use protocol stacks (OSI and TCP/IP) for developing data communication applications<br>2. Apply error detection & correction strategies for data transmission<br>3. Establish network of computing devices using topology and Ethernet standards<br>4. Experiment routing protocols and error reporting protocols<br>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

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

## 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.<br>2. To design and simulate a basic dc-dc power supply for given specifications.<br>3. To describe the operation and pulse width modulation strategies in inverters.<br>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:<br>1. Analyze any arbitrary dc-dc converter in steady state.<br>2. Design the output filter components to meet the required specifications.<br>3. Choose the appropriate switching device based on circuit operation.<br>4. Identify the various blocks in a practical PWM control circuitry.<br>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<br>2. To train the students for creating ladder logic for PLC processes programming.<br>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:<br>1. Ability to gain knowledge on Programmable Logic Controllers.<br>2. To provide the knowledge about various types of registers in PLC.<br>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.


| **Sub Code: BTEE15F5604** | **Programming in Java** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications)<br>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<br>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<br>4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Analyze the principles and concepts of object-oriented programming;<br>2. Use a Java-enabled browser and/or the appletviewer to execute Java applets<br>3. Use the Java interpreter to run Java applications<br>4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design. | | | | | |

| | |
|---|---|
| | 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',2nd Edition, John Wiley and Sons
2. Herbert Schildt, 'The Complete Reference Java J2SE', 5th 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


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

**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

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

**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.<br>2. To model and analyze the power systems under abnormal (or) fault conditions.<br>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<br>1. Carry out the fault analysis of transmission and distribution networks.<br>2. Computation of short circuit capacity analysis<br>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 = $A^T YA$), 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.

| Sub Code: BTEE15F6200 | High Voltage Engineering | C | L | T | P | CH |
|---|---|---|---|---|---|---|
| Duration: 14 Weeks | | 4 | 3 | 1 | 0 | 5 |
| **Course Objectives** | 1. To enable the students understand various breakdown mechanisms.<br>2. To enable the students understand various principles of generating high DC, AC and impulse voltages.<br>3. To teach the students about various methods for measuring high voltages and currents.<br>4. To teach the students various high voltage tests performed on various electrical apparatus such as cables, insulators etc. | | | | | |
| **Course Outcomes** | After the completion of the course the student will be able to:<br><br>1. Describe the principles of the generation and measurement of high voltage AC, DC and impulse voltages.<br>2. Describe the fundamentals of breakdown.<br>3. Understand discharge phenomena, to prevent them.<br>4. Know the origins of overvoltage and protection against them.<br>5. Understand insulation coordination concept | | | | | |

## 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', 4th edition, THM, 2008.
2. E.Kuffel and W.S. Zaengl, 'High Voltage Engineering Fundamentals', 2nd edition, Elsevier Press, 2005.
3. C.L.Wadhwa, 'High Voltage Engineering' , New Age International Private limited, 1995


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

| | |
|---|---|
| | 2. Design different applications using general purpose op- amp and application specific ICs.<br>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<br>2. To study the stability analysis of linear and non-linear systems<br>3. Develop ability to set up measurement systems with a control environment<br>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:<br>1. Ability to apply knowledge of advanced principles to the analysis of electrical and computer engineering problems.<br>2. Ability to apply knowledge of advanced techniques to the design of electrical and computer engineering systems.<br>3. At the end of the course students will be able apply the modeling concepts<br>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.


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

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|---|---|
| | 1. Be able to describe the operation of digital protection system.<br>2. Be able to classify various types of Static, digital Relays<br>3. Be able to describe the theory , construction , advantages and disadvantages of different types of Relays and their applications<br>4. Be able to design distance protection schemes<br>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


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

## 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.<br>2. Describe conceptual data models and ER diagrams. | | | | | |

| | |
|---|---|
| | 3. Explain theoretical concepts of the relational data model and the relational algebra.<br>4. Describe the use of SQL commands for database operations.<br>5. Illustrate database design concepts and normalization with examples |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Apply the knowledge to design database schemas.<br>2. Design ER diagrams for given data models.<br>3. Use database concepts and relational models for building database applications.<br>4. Develop database applications for industrial projects.<br>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<br>2. To illustrate the basic concepts of Expansion planning.<br>3. To introduce the objectives of Load forecasting | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Be able to describe the planning process of the power system.<br>2. Be able to identify the suitable techniques for load forecasting and modeling.<br>3. Be able to identify various measures has to taken while planning a power system.<br>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.<br>2. To know the concepts of representing transfer function model of a DC machine.<br>3. To understand the importance of 3-phase to 2-phase conversion.<br>4. To know the representation of 3-phase induction motor in various reference frames<br>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:<br>1. Develop models for linear and nonlinear magnetic circuits<br>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<br>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.<br>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.<br>2. To study the various techniques for effective decision making to solve business decision problems.<br>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:<br>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.<br>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

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

## 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"

| Sub Code:BTEE15F6601 | Smart Grid | C | L | T | P | CH |
|---|---|---|---|---|---|---|
| Duration: 14 Weeks | | 4 | 3 | 2 | 0 | 5 |
| **Course Objectives** | 1. To understand the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.<br>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.<br>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.<br>4. To understand the concept of microgrid and its integration with main central grid. | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Differentiate Conventional and Smart Grid.<br>2. Adopt smart meters in industries and residential sector<br>3. Identify the need of Smart Grid, Micro Grid, Smart metering, Smart storage, Hybrid Vehicles, Home Automation, Smart Communication.<br>4. Use smart technologies that will enhance the reliability and energy efficiency of distribution system.<br>5. Comparing and getting acquainted with emerging technologies and current professional issues in electric Grid<br>6. Implement the use of renewable energy systems in the distribution system. | | | | | |

## 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.<br>2. What are the key DSP concepts and how do they relate to real applications?<br>3. Master the representation of discrete-time signals in the frequency domain, using z-transform, discrete Fourier transform (DFT), and cosine transform.<br>4. Understand the implementation of the DFT in terms of the FFT, as well as some of its applications<br>5. Learn the basic forms of FIR and IIR filters, and how to design filters with desired frequency responses.<br>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:<br>1. Represent discrete-time signals analytically and visualize them in the time domain.<br>2. Understand the meaning and implications of the properties of systems and signals.<br>3. Understand the Transform domain and its significance and problems related to computational complexity.<br>4. Be able to specify and design any digital filters using MATLAB | | | | | |

## COURSE CONTENTS

**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

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

## 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.<br>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.<br>3. Provide the students with solid foundations in the basic concepts of programming: data structures and algorithms.<br>4. Familiarize the concept of Abstract Data Types (ADT)<br>5. and Implement ADT in several programming languages | | | | | |

| | |
|---|---|
| **Course Outcomes** | On completion of this course the students will be able to:<br>6. Implement classes and objects for a given problem.<br>7. Demonstrate the ability of accessing members in the written programs.<br>8. Impart the effectiveness of data structures and algorithms for solving a given problem.<br>9. Package a set of data structures and algorithms as an<br>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.<br>2. To give an insight into usage of software packages like MATLAB for the realization of circuits without actually exciting them.<br>3. To enable the student to understand the working of circuits.<br>4. To practice different types of wiring and devices connections.<br>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:<br>1. Be able to feel the hands on experience.<br>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.<br>3. Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors.<br>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.<br>2. To give an insight into usage of software packages like MATLAB/SCILAB for the realization of physical modules without actually exciting them.<br>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:<br>1. Be able to understand the usage of measuring and testing equipment for different applications.<br>2. Be able to feel the hands on experience.<br>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<br>2. Power System Analysis<br>3. To enable students to understand the analysis of power system network topologies<br>4. To enable students to learn the concept of power flow and its analysis by different<br>5. methods<br>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:<br>1. able to identify the incidence of elements of given power system network<br>2. able to solve different examples related to network topology<br>3. able to identify state of the power system through different load | | | | | |

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| | flow techniques<br>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.<br>2. To provide an overview of various sectional views of electrical machines.<br>3. To understand the basic sense of measurement.<br>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:<br>1. Work with Auto CAD 2D classic and execute the basic commands of auto cad software<br>2. Draw the isometric and orthographic views of given objects<br>3. Draw the sectional views of Electrical Machines<br>4. Differentiate between single and three phase systems<br>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]**

**L**aunching 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<br>2. To identify and demonstrate appropriate research methodologies and know when to use them<br>3. To define, articulate and use terminology, concepts, and theory in their field and know how to use them<br>4. To use library and other tools to search for existing body of research relevant to their topic<br>5. To know existing body of research relevant to their topic and explain how their project fits<br>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:<br>1. Define research problem and formulate the hypothesis<br>2. Demonstrate research methodologies<br>3. Define terminology and understand the concepts related to the same<br>4. Do rigorous literature survey based on the problem defined<br>5. Compare the existing body of research and their proposed work<br>6. Practice research ethics<br>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

| **Sub Code: BTEE15F7401** | **Power System Protection** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To understand the methods of representation of systems and to desire their transfer function models reduction of blockdiagrams.<br>2. To provide adequate knowledge in the time response of systems and steady state error analysis, different types of controller.<br>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.<br>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:<br>1. Describe the operation of switch gear and protection system.<br>2. Classify various types of Circuit Breakers and Relays<br>3. Explain the theory, construction, advantages and disadvantages of different types of Circuit Breakers and Relays.<br>4. Describe protection schemes for transformers, alternators and induction motors<br>5. List the applications of circuit breakers and relays in real life | | | | | |

## 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.<br>2. To understand the concepts of HVDC converter, control of HVDC system, how faults occur and protection against thesame.<br>3. To understand the function of smoothing reactor, dc line, power flow analysis and MTDC systems.<br>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:<br>1. Understand what HVDC system is, how it differs from AC, why it is required, and what are the advantages and disadvantages.<br>2. Understand how the control of HVDC system is achieved, the faults in the HVDC system and how protection is done against the same.<br>3. Understand the function of smoothing reactor, various concepts of DC line, power flow analysis and MTDC systems.<br>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.<br>2. Bring out the various measurements involved in Power Plants.<br>3. Familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines & their control<br>4. Know about the tools like PLC, DCS, and SCADA | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Select instruments and transducers for various physical variables.<br>2. Get an insight on data acquisition, processing and monitoring system.<br>3. Design various signal conditioning systems for transducers.<br>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.

| Sub Code: BTEE15F7404 | Operating Systems | C | L | T | P | CH |
|---|---|---|---|---|---|---|
| Duration: 14 Weeks | | 4 | 3 | 1 | 0 | 5 |
| **Course Objectives** | 1. Introduce the history, basics and structure of Operating System<br>2. Describe process concepts and scheduling techniques<br>3. Familiarize with physical and virtual memory management techniques<br>4. Describe UNIX kernel, data structures and internal representation of files in UNIX operating system<br>5. Illustrate Inter process communication mechanisms | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Explain the history, basics and structure of operating systems<br>2. Implement various process management and scheduling schemes<br>3. Design and develop memory management techniques<br>4. Demonstrate the internals of UNIX operating system<br>5. Use the computing environment and various services of operating system for development of applications. | | | | | |

## 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


| **Sub Code: BTEE15F7501** | **Testing and Commissioning of Electrical Equipment** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To enable students to understand the standard specifications of various electrical equipment as per BIS(Bureau of Indian Standard)<br>2. To enable the students to understand standard tests forinstallation of various electrical equipment as per BIS(Bureau of Indian Standard)<br>3. To enable the students to understand standard commissioning tests various electrical equipment as per BIS(Bureau of Indian Standard)<br>4. To enable the students to understand standard performance tests of various electrical equipment as per BIS(Bureau of Indian Standard) | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to: | | | | | |

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| | 1. Be able to describe the standard specifications of various electrical equipment.<br>2. Be able to describe the standard tests, specifications for installation of various electrical equipment<br>3. Be able to describe the commissioning tests on various equipment<br>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.<br>2. To understand the provisions provided in Indian Electricity Act 2003.<br>3. To highlight about the Electricity scenario in India<br>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: | | | | | |

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| | 1. Apply the electricity rules 1956 for electrical equipment and also power systems.<br>2. Apply the provisions given in Electricity act 2003 in Electrical power generation, transmission and distribution system.<br>3. Adopt the norms given by KERC and CERC for power system.<br>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.<br>2. To understand the solar geometry required to estimate the solar radiation.<br>3. To estimate maximum power available in wind.<br>4. To introduce various renewable energy conversion technologies like Biomass, Geothermal, Ocean energy.<br>5. To introduce Magnetohydrodynamic system and energy storage | | | | | |

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|---|---|
| | systems |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Select the appropriate renewable energy as an alternate for conventional power in any application.<br>2. Design solar PV module for any given application.<br>3. Deduce maximum power available in any given location.<br>4. Acquire the knowledge of modern energy conversion technologies.<br>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.<br>2. To measure HVAC and HVDC using spheres.<br>3. To analyze the characteristics of fuse. | | | | | |
| **Course outcomes** | At the end of this course, Student will be able to:<br>1. Develop skills to measure HVAC and HVDC parameters.<br>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:<br>1. Acquire skills of using computer packages MATLAB coding | | | | | |

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| | and SIMULINK in power electronics and power system studies.<br>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<br>2. To know and apply problem solving skills to constructively address research setbacks<br>3. To work collaboratively with other researchers, using listening and communication skills<br>4. To work autonomously in an effective manner and setting and meeting deadlines<br>5. To reflect on their own research, identifying lessons learned, strengths, and ways to improve<br>6. To communicate confidently and constructively withfellow graduate students and faculty as mentors<br>7. To explain their research to others in the field and to broader audiences through research presentations<br>8. To articulate the relevance of their research to their coursework and professional future, synthesizing their research, academic, and professional interests and goals<br>9. To identify and describe what they could expect as a | | | | | |

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| | graduate student<br>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:<br>1. Apply relevant knowledge and skills, within the main area, to a given problem - within given constraints,<br>2. Analyze and discuss complex inquiries/problems and handle larger problems independently even with limited information<br>3. Evaluate and critically assess one's own and others' scientific results<br>4. Document and present one's work with strict requirements on structure, format, and language usage<br>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).<br>2. To provide a solid foundation in mathematical and engineering fundamentals required to control the governing system in Turbine models.<br>3. To provide the knowledge of hydrothermal scheduling, Unit | | | | | |

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| | Commitment problem.<br>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:<br>1. To make students understand Economic operation of power system and importance of LFC control.<br>2. To allow students discuss about thermal and hydro power plants operation in meeting the load demand optimally. (State and central wide installation).<br>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.<br>4. Apply their knowledge in PSOC for competitive exams like GATE, IES, and Public sector etc.<br>5. Ability to discuss single area load frequency control and two area load frequency control.<br>6. Ability to model and design turbine and Automatic controller.<br>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.<br>2. To review the static devices for series and shunt control.<br>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:<br>1. Describe the need of flexible AC transmission and the associated problems.<br>2. Describe the characteristics, applications and modelling of series and shunt FACTS controllers.<br>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 | | | | | |

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| | various electrical components for wiring<br>2. To enable students to describe the standard tests, specifications for installation of various electrical installation.<br>3. To enable students to design simple residential ,commercial and power installation ,overhead lines, transmission lines , substations<br>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:<br>1. Be able to describe the standard specifications of various electrical components for wiring<br>2. Be able to describe the standard tests, specifications for installation of various electrical installation<br>3. Be able to design simple residential ,commercial and power installation ,overhead lines, transmission lines , substations<br>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** | | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | **Artificial Neural Network** | **4** | **3** | **2** | **0** | **5** |
| **Course Objectives** | 1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modeling<br>2. Provide knowledge of supervised learning in neural networks<br>3. Provide knowledge of computation and dynamical systems using neural networks<br>4. Provide knowledge of reinforcement learning using neural networks.<br>5. Provide knowledge of unsupervised learning using neural networks.<br>6. Provide hands-on experience in selected applications | | | | | |
| **Course Outcomes** | 1. Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.<br>2. Understand Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory<br>3. Competitive learning, Self-organizing feature maps<br>4. Understand the concepts and techniques of neural networks through the study of the most important neural network models. | | | | | |

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| | 5. Gain knowledge of sufficient theoretical background to be able to reason about the behavior of neural networks.<br>6. Evaluate whether neural networks are appropriate to a particular application.<br>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.

| **Sub Code: BTEE15F8301** | **Electrical Power Quality** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To provide basic concepts about power quality issues like voltage variation and frequency variation in electrical distribution system.<br>2. To provide basic concepts about linear and non-linear loads and their effects on power quality.<br>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.<br>4. To expose students to the various techniques of alleviating power quality problems. | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Differentiate between linear and non-linear loads and their effects on power distribution system.<br>2. Take remedial measures against voltage flickers, harmonics and other power quality related issues so as to ensure safe operating conditions for equipment.<br>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.<br>4. Model an electrical industrial distribution system, carryout systematic harmonic analysis and design filters to suppress harmonics so as to comply with industrial standards. | | | | | |

**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

| **Sub Code: BTEE15F8302** | **Electrical Distribution System** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To give an overview of the function of an electrical power distribution in an electric power system.<br>2. To have the wider knowledge on planning and design of a distribution infrastructure | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Describe the design of distribution system.<br>2. Analyze the different types of network.<br>3. Describe the optimization techniques involved in the planning of distribution system | | | | | |

## 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.<br>2. To provide an overview of information regarding use of safe electrical equipment.<br>3. To understand the importance of use of safety gadgets, safe practices while working on electrical equipment.<br>4. To understand and need of protection to avoid electrical hazards.<br>5. To understand the different electrical safety standards and practice regularly | | | | | |

| | |
|---|---|
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Understand the basic electric safety norms.<br>2. Adopt the best & safe practices while doing electrical work.<br>3. Understand the various IE rules for safe operation.<br>4. Understand the importance of earthing and other related safety equipments<br>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

| **Sub Code: BTEE15F8401** | **Management and Entrepreneurship** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To explain the basic concepts, principles, and processes of management.<br>2. To use the elements of effective decision making–research, assessment and consequence.<br>3. To develop the abilities to plan for effective communication – learn how to reflect, present and evaluate communication.<br>4. To Analyse organizational practices that facilitate creativity and innovation<br>5. To Integrate functional areas into strategic business problems from a general management perspective<br>6. To develop an ability to work with moral and ethical dilemmas and make decisions using critical thinking | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Integrate management concepts in a technical and innovative setting as required by today's dynamic business environment<br>2. Possess relevant skills preparing students for entry into management careers in business, government, public, or social service organizations<br>3. Analyse a business case, propose a creditable solution to a business problem and support your decision with strong arguments.<br>4. Propose his/her own business ideas and present it to a relevant audience.<br>5. Apply elements of effective decision making to areas that are central to career development – self assessment, market conditions and planning. | | | | | |

## 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<br>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.<br>3. To provide an overview of various energy conservation opportunities for electrical equipment.<br>4. To study the importance of energy conservation for reduction of environmental burden.<br>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:<br>1. Understand the energy losses in different equipment and control the losses<br>2. Develop capability in measurement and analysis of data to conserve energy.<br>3. Conduct performance test on electrical equipment and calculate the energy efficiency of equipment.<br>4. Develop the awareness on controlling of environmental pollution through implementing energy conservation measures.<br>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 | | C | L | T | P | CH |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | **Computer Control of Electric Drives** | **4** | **3** | **2** | **0** | **5** |
| **Course Objectives** | 1. To understand the basics of mathematics applied to electrical drives.<br>2. Understand the basics of magnetic circuits as applicable to the electrical machines.<br>3. Describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives.<br>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:<br>1. On completion of this course the students will be able to:<br>2. Understand the concepts and basic operation of electric drive system<br>3. Understand closed loop operation of dc, induction and synchronous machine drives<br>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'.


| **Sub Code: BTEE15F8404** | **Trouble Shooting of Common Electrical Appliances** | **C** | **L** | **T** | **P** | **CH** |
|---|---|---|---|---|---|---|
| **Duration: 14 Weeks** | | **4** | **3** | **1** | **0** | **5** |
| **Course Objectives** | 1. To teach safety rules , important tools used in trouble shooting<br>2. To teach different types of wires & wire splicing, termination.<br>3. To teach usage of important electrical meters which are used in the process of trouble shooting.<br>4. To teach probable faults, causes & remedies on some common electrical equipment. | | | | | |
| **Course Outcomes** | On completion of this course the students will be able to:<br>1. Understand safety rules , important tools used in trouble shooting<br>2. Understand different types of wires & wire splicing ,<br>3. Understand the usage of important electrical meters which are used in the process of trouble shooting.<br>4. Find out faults, causes and remedies for common electrical equipment. | | | | | |

## 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<br>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 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | | | | | | | |
| BTEE15F8100 | CO1 | 3 | 3 | 2 | 2 | 3 | | | | 1 | | | |
| | CO2 | 2 | 2 | 2 | 2 | 1 | | | | 1 | 2 | | |
| | 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 | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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.

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**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.

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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