

10 YEARS
OF UNIVERSITY
RECOGNITION
20 YEARS OF
ACADEMIC
EXCELLENCE



REVA
UNIVERSITY

Bengaluru, India

School of CSA

Master of Science in Computer Science (MS-CS)

HANDBOOK 2017-2018

Rukmini Knowledge Park
Kattigenahalli, Yelahanka, Bengaluru – 560064
www.reva.edu.in

REVA GROUP OF EDUCATIONAL INSTITUTIONS

REVA University
REVA Institute of Technology and Management
REVA Institute of Science and Management
REVA Institute of Management Studies, Ganganagar
REVA Institute of Education, Ganganagar
REVA First Grade College, Sanjaynagar
REVA Independent PU College, Kattigenahalli
REVA Independent PU College, Ganganagar
REVA Independent PU College, Sanjaynagar



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Rukmini Educational
Charitable Trust

SCHOOL OF
COMPUTER SCIENCE
AND APPLICATIONS

M.S. Computer Science

HAND BOOK

OUR VISION

REVA University aspires to become an innovative university by developing excellent human resources with leadership qualities, ethical and moral values, research culture and innovative skills through higher education of global standards.

OUR MISSION

1. To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centers.
 2. To provide student-centric learning environment through innovative pedagogy and educational reforms.
 3. To encourage research and entrepreneurship through collaborations and extension activities.
 4. To promote industry-institute partnerships and share knowledge for innovation and development.
 5. To organize social development programs for knowledge enhancement in thrust areas.
 6. To enhance leadership qualities among youth, to enrich personality traits and promote patriotism and moral values;
-

BROAD OBJECTIVES

1. Creation, preservation and dissemination of knowledge and attainment of excellence in different disciplines.
2. Smooth transition from teacher-centric focus to learner-centric processes and activities.
3. Performing all the functions of interest to its major constituents like faculty, staff, students and society to reach leadership positions.
4. Developing a sense of ethics in the University community, making it conscious of its obligations to society and the nation.
5. Accepting the challenges of globalization to offer high quality education and other services in a competitive manner.

DO'S AND DON'TS

DO'S

1. Maintain discipline and respect the rules and regulations of the university
 2. Be regular and punctual to classes
 3. Study regularly and submit assignments on time
 4. Be respectful to your Teachers/friends and hostel staff/management.
 5. Read the notice board (both at your college and the hostel) regularly.
 6. Utilize your Personal Computer for educational purpose only.
 7. Follow the code of conduct.
 8. Visit Health Center on the campus whenever you are unwell.
 9. Be security conscious and take care of your valuables especially Cash, Mobile Phones, Laptop and other valuables.
 10. Carry your valuables along with you whenever you proceed on leave/vacation.
 11. Use electric appliances, lights and water optimally.
 12. Keep the campus clean and hygienic.
 13. Use decent dressing.
-

DON'TS

1. Ragging inside / outside the campus.
2. Possession of Fire arms and daggers etc.
3. Use of Alcohols, Toxic drugs, sheesha, gutkha and hashish/heroin etc.
4. Use of Crackers, explosives and ammunition etc.
5. Smoking and keeping any kind of such items.
6. Misusing college & hostel premises/facilities for activities other than studies.
7. Playing loud music in the room which may disturb studies of colleagues / neighbours.
8. Making noise and raising slogans.
9. Keeping electrical appliances, other than authorized ones.
10. Involvement in politics, ethnic, sectarian and other undesirable activities.
11. Proxy in any manner.
12. Use of mobiles in the academic areas.

- Note:**
1. Rules are revised / reviewed as and when required.
 2. Healthy suggestions are welcome for betterment of Institution



REVA
UNIVERSITY

Bengaluru, India

**SCHOOL OF COMPUTER
SCIENCE AND APPLICATIONS**

**M.S. Computer Science
Specialization in Data Science and Analytics**

HAND BOOK - 2017

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MESSAGE FROM THE HON'BLE CHANCELLOR

Dr. P. Shyama Raju

Chancellor
REVA University

“Education is the most powerful weapon which you can use to change the world.”

- Nelson Mandela.

There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when ‘intellectual gratification’ has become indispensable. Information is easily attainable for the soul that is curious enough to go look for it. Technological boons enable information availability anywhere anytime. The difference, however, lies between those who look for information and those who look for knowledge.

It is deemed virtuous to serve seekers of knowledge and as educators it is in the ethos at REVA University to empower every learner who chooses to enter our portals. Driven by our founding philosophy of ‘Knowledge is power’, we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

India has always been beheld as a brewing pot of unbelievable talent, acute intellect and immense potential. All it takes to turn those qualities into power is a spark of opportunity. Being at a University is an exciting and rewarding experience with opportunities to nurture abilities, challenge cognizance and gain competence.

For any University, the structure of excellence lies in the transitional abilities of its faculty and its facility. I’m always in awe of the efforts that our academic board puts in to develop the team of subject matter experts at REVA. My faculty colleagues understand our core vision of empowering our future generation to be ethically, morally and intellectually elite. They practice the art of teaching with a student-centered and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

A famous British politician and author from the 19th century - Benjamin Disraeli, once said ‘A University should be a place of light, of liberty and of learning’. Centuries later this dictum still inspires me and I believe, it takes team-work to build successful institutions. I welcome you to REVA University to join hands in laying the foundation of your future with values, wisdom and knowledge.

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.



A strong believer and practitioner of the dictum “Knowledge is Power”, REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this ‘temple of learning’ has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.

All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe

sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of “Technology Incubation Centers” in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

With firm faith in the saying, “Intelligence plus character –that is the goal of education” (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavour to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating “GLOBAL PROFESSIONALS”. Welcome to the portals of REVA University

Dr.S. Y. Kulkarni

Vice-Chancellor REVA University

Director –Message

It's my pleasure to welcome you to the School of Computer Science and Applications. Computer, being considered as most significant and revolutionary invention of mankind has metamorphosed the planet earth completely. Predominantly School of Computer Science and Applications have acquired the control of the modern life in a myriad way.



The MS (Computer Science) program is designed keeping in view the current situation and possible future developments, both at national and global levels. This program is designed to give greater emphasis on computer science. There are ample number of courses providing knowledge in specialized areas of network security, python programming and cloud computing etc. facilitating students to choose specialized areas of their interest. Adequate attention is given to provide students the basic concepts in computer applications.

The program is designed to expose students to various subjects having applications in computers, IT and electronics related industries through outcome based teaching and learning process which emphasizes practical exposure rather than memorization. A variety of activities such as mini projects, seminars, interaction with industries, cultural activities and social activities are in place to shape the all-round development of students.

The benefits of choosing MS (Computer Science) program are:

- Flexibility to choose various fields upon graduation.
- Opportunity to work on live problems.
- Opportunity to work on environmental related technologies.
- Opportunity for programmers to develop software for varied applications in different sectors.

Students after successful completion of MS (Computer Science) program:

- Can start-up their career in either government sector or private sector since there are ample employment opportunities in these sectors.
- Can also start their career as software programmers / engineers, testing engineers, data base administrators, system and network administrators, multimedia / web programmers, web designers etc.,
- Can seek placements in diversified fields like banking, e-commerce, insurance, entertainment, and such others.
- The computer application trained graduates are sought after by varied firms for their software based skills.
- Can opt for higher studies in computer science, IT, business management and so on.

The curriculum caters to and has relevance to local, regional, national and global development needs. All courses are focussed on building skill, employability and entrepreneurship of students. Maximum number of courses are integrated with cross cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

I am sure the students choosing MS (Computer Science) in REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced teachers involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies.

I wish all students pleasant stay in REVA and grand success in their career.

Dr. S. Senthil

Director – School of Computer Science and Applications

RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 14,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

ABOUT REVA UNIVERSITY

REVA University has been established under the REVA University Act, 2012 of Government of Karnataka and notified in Karnataka State Gazette No. 80 dated 27thFebruary, 2013. The University is empowered by UGC to award degrees any branch of knowledge under Sec.22 of the UGC Act. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

REVA University located in between Kempegowda International Airport and Bangalore city, has a sprawling green campus spread over 45 acres of land and equipped with state-of-the-art infrastructure that provide conducive environment for higher learning and research. The REVA campus has well equipped laboratories, custom-built teaching facilities, fully air-conditioned library and central computer centre, the well planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 23 Post Graduate Degree programs, 20 Degree and PG Degree programs in various branches of studies and has 12000+ students studying in various branches of knowledge at graduate and post graduate level and 302 Scholars pursuing research leading to PhD in 18 disciplines. It has 800+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on practice in respective areas and skill development to suit to respective job environment has been given while designing the curricula. The Choice Based Credit System and Continuous Assessment Graded Pattern (CBCS – CAGP) of education has been introduced in all programs to facilitate students to opt for subjects of their choice in addition to the core subjects of the study and prepare them with needed skills. The system also allows students to move forward under the fast track for those who have the capabilities to surpass others. These programs are taught by well experienced qualified faculty supported by the experts from industries, business sectors and such other organizations. REVA University has also initiated

many supportive measures such as bridge courses, special coaching, remedial classes, etc., for slow learners so as to give them the needed input and build in them confidence and courage to move forward and accomplish success in their career. The University has also entered into MOUs with many industries, business firms and other institutions seeking their help in imparting quality education through practice, internship and also assisting students' placements.

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless Sensor Networks, Computer Networks, IOT, MEMS, Nano-Electronics, Wireless Communications, Bio-fuels, Nano-technology for coatings, Composites, Vibration Energies, Electric Vehicles, Multilevel Inverter Application, Battery Management System, LED Lightings, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counselors and Placement Officers.

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by

NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Oklahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC², VMware, SAP, Apollo etc, to facilitate student exchange and teacher-scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

The University has also given greater importance to quality in education, research, administration and all activities of the university. Therefore, it has established an independent Internal Quality division headed by a senior professor as Dean of Internal Quality. The division works on planning, designing and developing different quality tools, implementing them and monitoring the implementation of these quality tools. It concentrates on training entire faculty to adopt the new tools and implement their use. The division further works on introducing various examination and administrative reforms.

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat Ratna Prof. C. N. R. Rao, a renowned Scientist, Dr. N R Narayana Murthy, Founder and Chairman and Mentor of Infosys, Dr. K Kasturirangan, Former Chairman ISRO, Member of Planning Commission, Government of India, Dr. Balaram, Former Director IISc., and noted Scientist, Dr. V S Ramamurthy, Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is 'Life Time Achievement Award' to be awarded to successful personalities who have made mark in their field of

work. This award is presented on occasion of the “Founders’ Day Celebration” of REVA University in presence of dignitaries, faculty members and students gathering and the first “REVA Life Time Achievement Award” for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO on the occasion of Founder’s Day Celebration, 6th January, 2016 and the second “REVA Life Time Achievement Award” for the year 2016 has been awarded to Shri. Shekhar Gupta, Renowned Journalist on the occasion of Founder’s Day Celebration, 6th January, 2017.

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. One of such cultural events is REVAMP conducted every year. The event not only gives opportunities to students of REVA but also students of other Universities and Colleges. During three days of this mega event students participate in debates, Quizzes, Group discussion, Seminars, exhibitions and variety of cultural events. Another important event is Shubha Vidaaya, - Graduation Day for the final year students of all the programs, wherein, the outgoing students are felicitated and are addressed by eminent personalities to take their future career in a right spirit, to be the good citizens and dedicate themselves to serve the society and make a mark in their respective spheres of activities. During this occasion, the students who have achieved top ranks and won medals and prizes in academic, cultural and sports activities are also recognised by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes everyday to students, faculty members, administrative staff and their family members and organises yoga camps for villagers around.

Recognizing the fast growth of the university and its quality in imparting higher education, the BERG (Business Excellence and Research Group), Singapore has awarded BERG Education Award 2015 to REVA University under Private Universities category. The University has also been honoured with many more such honors and recognitions.

SCHOOL OF COMPUTER SCIENCE AND APPLICATIONS

The School of Computer Science and Applications is equipped with highly qualified and experienced faculty members. The school has the state-of-the-art class rooms and advanced computer laboratory. The School offers BCA, B.Sc (Honors), MCA and MS (Computer Science) programs. The School also has research program leading to doctoral degree. The curriculum of both graduate and post graduate degree programs have been designed to bridge the gap between industry – academia and hence they are industry oriented. These programs provide ample scope to enter into a wide range of business opportunities. This is reflected in various core subjects / courses offered within the program.

VISION

To transform students into good human beings, responsible citizens and competent professionals, focusing on assimilation, generation and dissemination of knowledge in the area of Computer Applications

MISSION

- To impart quality education to meet the needs of profession and society, and achieve excellence in teaching-learning and research in the area of Computer Applications;
- To attract and develop talented and committed human resource, and provide an environment conducive to innovation, creativity, team-spirit and entrepreneurial leadership in Computing field;
- To facilitate effective interactions among faculty and students of the School of Computer Applications, and foster networking with alumni, industries, institutions and other stakeholders; and
- To practice and promote high standards of professional ethics, transparency and accountability.

OBJECTIVES

- To impart course and programs at graduate, post-graduate and doctorate levels in the field of computer applications;
- To adopt innovative methods of teaching and promote student centric learning process;
- To create infrastructure of international standard and facilitate and create conducive environment for teaching, learning and research;
- To promote faculty development and encourage faculty members and students to organize and participate in national and international level conferences, seminars, symposia and such others;

- To encourage teachers and students to take-up interdisciplinary studies and research;
- To promote students participation in co-curricular and extension activities and develop their personality traits and team spirit.

VALUES

- Excellence in all our academic and research endeavours
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto
- Integrity and intellectual honesty
- Ethical and moral behaviour
- Freedom of thought and expression
- Adaptability to the change
- Team-work

M.S. Computer Science Specialization in Data Science and Analytics

Program Objectives:

The Post Graduate / Under Graduate in Computer Science and Applications from REVA University after 3 - 5 years completion of the programme shall:

- Demonstrate as a successful Software Professional with INNOVATIVE SKILLS, MORAL and ETHICAL VALUES.
- Engage in life-long learning through RESEARCH and Professional development.
- Serve as a LEADER in the profession through consultancy, extension activities, RESEARCH and Entrepreneurship.

Program Outcomes:

- a) Able to apply knowledge of mathematical, scientific, and computer science to evaluate, analyze, synthesize, model and integrate technologies to develop new computer system for applied systems.
- b) Analyze complex problems critically related to Computer Science domain, apply independent judgment for synthesizing information to make intellectual and/or creative advances with a research perspective.
- c) An ability to work upon unfamiliar problems through investigative studies and research and contribute to the development of technological knowledge and intellectual property.
- d) Function on multidisciplinary teams with positive attitude.
- e) Identify, formulate, and solve problems in accordance with the relevant standard codes of practice.
- f) Apply knowledge of research methodologies in their disciplines and capacity to interpret findings.
- g) Recognize the need for, and an ability to engage in life-long learning.
- h) Understand contemporary issues in providing technology solutions for sustainable development considering impact on economic, social, political, and global issues and thereby contribute to the welfare of the society.
- i) Understand the role of Software developers and ethical responsibility.
- j) Communicate effectively through verbal, written and graphical modes.

ADVISORY BOARD

SL. No	NAME
1	Dr. Anand Kumar Professor and Dean-Academics, MCA Department, M.S Engineering College
2	Dr. Muralidhar B.L Professor and Coordinator, MCA Programme, Bangalore University
3	Dr. Dharani Dhamre Professor, Dept of MCA, RVCE
4	Mr. Manikantan Mohanavelu Head Training Tower-India, HP
5	Mr. Madusudan R Practice Lead, Engagement & System Operations-IBM
6	Mr. Dharshan Maheshbhai Project Lead- Cognizant Technology Pvt Ltd
7	Mr. Ashish Tanwar, University Relations Manager-India, Dell

“Education is the manifestation of the perfection already in man”

- *Swami Vivekananda*

“The real danger is not that computers will begin to think like men, but that men will begin to think like computers.”

- *Sydney J. Harris*

“People think computers will keep them from making mistakes. They’re wrong. With computers you make mistakes faster.”

- *Adam Osborne*

The ladder of success is best climbed by stepping on the rungs of opportunity.

- *Ayn Rand*

Summary of REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Program

1.0 Teaching and Learning Process

The teaching and learning process under CBCS-CAGP of education in each course of study will have three components, namely-

(i) L= Lecture (ii) T= Tutorial (iii) P= Practice, where:

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

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

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

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

2.1. Various course of **study** are labeled and defined as: (i) Core Course (CC) (ii) Hard Core Course (HC), (iii) Soft Core Course (SC), (iv) Foundation Core Course (FC) and (v) Open Elective Course (OE).

(i) **Core Course:** A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course.

(ii) **Foundation Course (FC):**

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

(iii) **Hard Core Course (HC):**

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

(iv) **Soft Core Course (SC):**

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

(v) **Open Elective Course:**

An elective course chosen generally from other discipline / subject, with an intention to seek exposure is called an **Open Elective Course**.

2.2. Project Work:

Project work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem.

2.3. Minor Project:

A project work up to **Six to Eight credits** is called **Minor Project** work. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned.

2.4. Major Project / Dissertation:

A project work of **EIGHT, TEN, TWELVE, SIXTEEN or TWENTY** credits is called **Major Project** work. The Major Project / Dissertation shall be Hard Core.

3.0. Minimum Credits to be earned:

3.1. A candidate has to earn 96 credits for successful completion of M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree with a distribution of credits for different courses as prescribed by the university.

3.2. A candidate can enroll for a maximum of 32 credits per Semester. However he / she may not successfully earn a maximum of 32 credits per semester. This maximum of 32 credits does not include the credits of courses carried forward by a candidate.

3.3. Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 96 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree.

4.1. Add on Proficiency Diploma:

In excess to the minimum of 96 credits for the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics) degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the M.S in Computer Science / MS in Computer Science (with Specialization in Data Science and Analytics). The **Add -on Proficiency Certification / Diploma** so issued to the candidate contains the courses studied and grades earned.

5. Scheme of Assessment & Evaluation

5.1. The Scheme of Assessment and Evaluation will have **TWO PARTS**, namely;

- i. Internal Assessment (IA); and
- ii. Semester End Examination (SEE)

5.2. Assessment and Evaluation of each Course shall be for 100 marks. The Internal Assessment (IA) and Semester End Examination (SEE) of PG programs shall carry 50 marks each (i.e., 50 marks internal assessment; 50 marks semester end examination).

5.3. The 50 marks of Internal Assessment (IA) shall comprise of:

Internal Test	= 30 marks
Assignments	= 10 marks
Seminars	= 10 marks

5.4. There shall be **three internal tests** conducted as per the schedule given below. **The students have to attend all the three tests compulsorily.**

- **1st test** for 15 marks during **2nd part of the 6th week** of the beginning of the Semester;
- **2nd test** for 15 marks during **2nd part of the 13th week** of the beginning of the Semester; and
- **3rd test** for 15 marks during **2nd part of the 16th week** of the beginning of the Semester.

5.5. The coverage of syllabus for the said three tests shall be as under:

- For the **1st test** the syllabus shall be **First Unit and 1st half of Second Unit** of the Course;
- For the **2nd test** it shall be **Second half of Second Unit and Third Unit** of the Course;
- For the **3rd test** the syllabus will be **Fourth Unit** of the Course.

5.6. **Out of 3 tests, the highest marks secured in two tests are automatically considered while assessing the performance of the students.**

5.7. There shall be two Assignments and two Seminars each carrying 5 marks. Hence two assignments carry 10 marks (5+5 marks) and two seminars carry 10 marks (5+5 marks) as stated at Sl.No.5.3 above. In place of assignments and seminars, there shall be model designs or some

task based activity wherein the number of designs/ activity the marks each design / activity carries shall be decided by the respective School Board. However such decision shall be done well in advance and it should be announced before commencement of the Semester after communicating the same to the Registrar and Registrar (Evaluation) to avoid ambiguity and confusion among students and faculty members.

5.8. The Semester End Examination for 50 marks shall be held during 19th and 20th week of the beginning of the semester and **the syllabus for the semester end examination shall be entire 4 units.**

5.9. **The duration of the internal test shall be 75 minutes and for semester end examination the duration shall be 3 hours.**

5.10. There shall be double evaluation, viz, first valuation by the internal teachers who have taught the subject and second evaluation shall be the external examiner.

5.11. The average of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results.

Summary of Continuous Assessment and Evaluation Schedule

Type of Assessment	Period	Syllabus	Marks	Activity
Allocation of Topics for Assignments / Seminars / Model Design	Beginning of 5 th Week	First Unit and Second Unit		Instructional process and Continuous Assessment
First Internal Test	Second Part of 6 th Week	First Unit and 1 st half of Second Unit	15	Consolidation of First Unit and 1 st half of Second Unit
Submission of Assignments/ Model Design	8 th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Seminars	9 th Week	First Unit and Second Unit	5	Instructional process and Continuous Assessment
Second Internal Test	2 nd Part of 13 th Week	2 nd half of Second Unit and Third Unit	15	Consolidation of 2 nd half of Second Unit and Third Unit
Allocation of Topic for 2nd Assignment / Seminars	11 th Week	Third Unit and Fourth Unit		Instructional process and Continuous Assessment
Submission of Assignments/ Model Design	13 th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment
Seminars	14 th Week	Third Unit and Fourth Unit	5	Instructional process and Continuous Assessment

Third Internal Test	2 nd Part of 16 th Week	Fourth Unit	15	Consolidation of entire Fourth Unit
Semester End Practical Examination	17 th & 18 th Week	Entire Syllabus	50	Conduct of Semester - end Practical Exams
Preparation for Semester-End Exam	17 th & 18 th Week	Entire Syllabus		Revision and preparation for semester-end exam
Semester End Theory Examination	19 th and 20 th Week	Entire Syllabus	50	Evaluation and Tabulation
	End of 21 st Week			Notification of Final Grades

Note:

1. **As per the model making is concerned, the School shall decide about the Marks and the Number of Model Designs and as well the schedule of allocation and presentation of model design(s). If the model design carries 5 marks, there shall be two model designs; and in case of 10 marks, there shall be one model design. However, the decision of the School should be announced in the beginning of the Semester for students to avoid ambiguity and confusion.*

2. *Examination and Evaluation shall take place concurrently and Final Grades shall be announced latest by 5 day after completion of the examination.*

3. *Practical examination wherever applicable shall be conducted after 3rd test and before semester end examination. The calendar of practical examination shall be decided by the respective School Boards and communicated well in advance to the Registrar (Evaluation) who will notify the same immediately.*

6. Assessment of Performance in Practicals

6.1. The performance in the practice tasks / experiments shall be assessed on the basis of:

- a) Knowledge of relevant processes;
- b) Skills and operations involved;
- c) Results / products including calculation and reporting

6.2. The 50 marks meant for continuous assessment of the performance in carrying out practical shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	10 marks
iii	Performance of mid-term test (to be conducted while conducting second test for theory courses); the performance assessments of the mid-term test includes performance in the conduction of experiment and write up about the experiment.	20 marks
	Total	50 marks

6.3. The 50 marks meant for Semester End Examination, shall be allocated as under:

i	Conduction of semester end practical examination	30 marks
ii	Write up about the experiment / practical conducted	10 marks
iii	Viva Voce	10 marks
	Total	50 marks

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

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

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

i	Periodic Progress and Progress Reports (25%)
ii	Results of Work and Draft Report (25%)
iii	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

8. Provision for Appeal

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

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

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

9.0 Eligibility to Appear for Semester - end Examination.

Only those students who fulfill a minimum of 75% of attendance in aggregate of all courses including practical courses / field visits etc, as part of the program shall be eligible to appear for Semester End Examination.

10. Requirements to Pass a Course / Semester and Provision to Drop / withdraw Course

10.1 Requirements to Pass a Course

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50 + SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (12 marks) in Semester End Examination (SEE) which is compulsory.

10.2. Requirements to Pass a Semester

To pass the semester, a candidate has to secure minimum of 40% marks in each subject / course of study prescribed in that semester.

10.3. Provision to Carry Forward the Failed Subjects / Courses:

A student who has failed in a given number of courses in odd and even semesters shall move to next semester of immediate succeeding year and final year of the study. However, he / she shall have to clear all courses of all semesters within the double duration, i. e., within **four years** of admission of the first semester failing which the student has to re-register to the entire program.

10.4. Provision to Withdraw Course:

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is Soft Core Course or Open Elective Course.

A DROPPED course is automatically considered as a course withdrawn.

1. Re-Registration and Re-Admission:

11.1. A candidate's class attendance in aggregate of all courses in a semester is less than 75% or as stipulated by the University and is considered as dropped the semester and is not allowed to appear for Semester End Examination (SEE) shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

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

2. Attendance Requirement:

- a. All students must attend every lecture, tutorial and practical classes.
- b. In case a student is on approved leave of absence (e g:- representing the university in sports, games or athletics, placement activities, NCC, NSS activities and such others) and / or any other such contingencies like medical emergencies, the attendance requirement shall be minimum of 75% of the classes taught.
- c. Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (SEE) examination.
- d. Teachers offering the courses will place the above details in the School / Department meeting during the last week of the semester, before the commencement of SEE, and subsequently a notification pertaining to the above will be brought out by the Head of the School before the commencement of SEE examination. A copy of this notification shall also be sent to the office of the Registrar & Registrar (Evaluation).

e. Absence during Internal Test:

In case a student has been absent from a internal test due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Head of the School, for conducting a separate internal test. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

3. The Grade and the Grade Point:

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

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

O - Outstanding; A+-Excellent; A-Very Good; B+-Good; B-Above Average; C+-Average; C-Satisfactory; F – Unsatisfactory.

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

4. Provisional Grade Card:

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average (SGPA)**. This statement will not contain the list of DROPPED / WITHDRAWN courses.

14.1 Computation of SGPA

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

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student in a given semester, i.e : **SGPA (Si) = $\sum(C_i \times G_i) / \sum C_i$** where C_i is the number of credits of the i th course and G_i is the grade point scored by the student in the i th course.

Illustration for Computation of SGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4X9=36
Course 2	4	O	10	4X10=40
Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	A	8	3X8=24
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			205

Thus, **SGPA = $205 \div 24 = 8.54$**

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4X10=40
Course 2	4	A+	9	4X9=36
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18

Course 6	3	A	8	3X8=24
Course 7	2	B+	7	2X7=14
Course 8	2	O	10	2X10=20
	24			200

Thus, **SGPA = 200 ÷ 24 = 8.33**

15. Challenge Valuation:

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

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

16. Final Grade Card:

Upon successful completion of M.S in Computer Science / M.S in Computer Science with Specialization in Data Science and Analytics degree a Final Grade card consisting of Grades / CGPA of all courses successfully completed by the candidate shall be issued by the Registrar (Evaluation).

16.1. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for M.S in Computer Science / M.S in Computer Science with Specialization in Data Science and Analytics degree is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = $\sum(C_i \times S_i) / \sum C_i$ Where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

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

Illustration:**CGPA after Final Semester**

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 = 204.96
3	24	9.35	24x9.35 = 224.4
4	24	9.50	24x9.50 = 228.0
Cumulative	96		857.28

Thus, $CGPA = \frac{24 \times 8.33 + 24 \times 8.54 + 24 \times 9.35 + 24 \times 9.50}{96} = 8.93$

CONVERSION OF GRADES INTO PERCENTAGE:

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

Illustration: CGPA Earned 8.93 x 10=89.30

17. Classification of Results

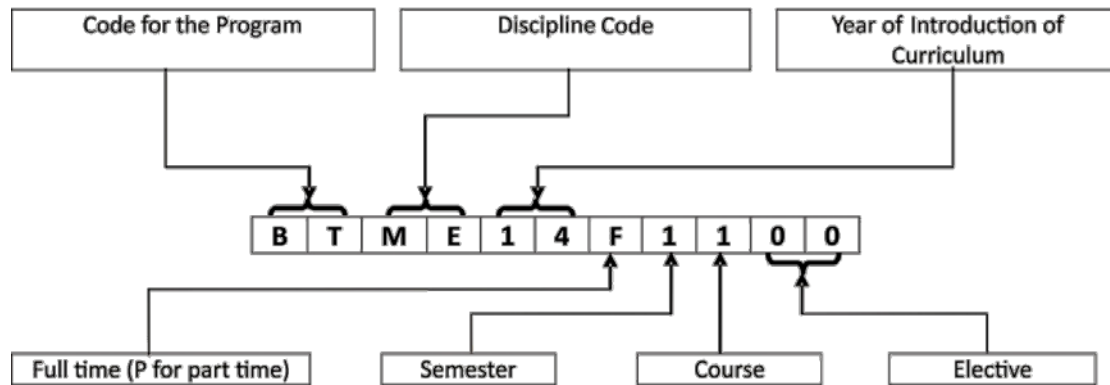
The final grade point (FGP) to be awarded to the student is based on CGPA secured by the candidate and is given as follows.

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

Overall percentage=10*CGPA

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

COURSE NUMBERING SCHEME



List of Codes for Programs and Disciplines / Branch of Study

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

M.S. Computer Science Specialization in Data Science and Analytics Program

Programme Overview

Computers have become ubiquitous part of modern life, and new applications are introduced every day. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse. Since 2001, global information and communication technologies (ICTs) have become more powerful, more accessible, and more widespread. They are now pivotal in enhancing competitiveness, enabling development, and bringing progress to all levels of society.

The career opportunities for Master of Science in computer science graduates are plenty and growing. Programming and software development, Information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the areas where the graduates find opportunities.

The School of Computer Science and Applications at REVA UNIVERSITY is offering Master of Science in Computer Science (MS) –a two year postgraduate programme. The aim of the programme is to create motivated, innovative, creative thinking graduates to fill in the roles of Software Engineers who can conceptualize, design, analyze and develop computer software to meet the modern day industry requirements.

This MS programme in Computer Science is offered by **School of Computer Science and Applications at REVA UNIVERSITY in collaboration with University of Alabama in Huntsville (UAH), USA. The students of this programme who completes first year of study successfully at REVA University has a choice either to pursue their second year of study at UAH or continue in REVA.**

The programme is designed to develop human resources to meet the challenges of ever-growing technologically advanced IT industry and digital revolution. The programme deals with important present day topics like data analytics; information security; Data warehousing and Data mining; mobile application development and cloud computing.

Programme Educational Objectives (PEOs)

The aim of the programme is to produce postgraduates with advanced knowledge and understanding of Computer Science; higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of ICT industry, academics, research establishments or take up entrepreneurial route.

Program Educational Objectives (PEO's)

The programme educational objective of the Master of Science in Computer Science of REVA University is to prepare graduates

The Programme Educational Objectives are to prepare the students to:

PEO-1	Be skilled Computer Application Developers, Use existing algorithms to develop computer applications, Provide computer based solutions for real life problems, Design, develop and test software /computer applications for specific needs
PEO-2	Understand the concepts and theories behind computer science and Adapt to the upcoming trends and technologies to the level of developing of commercially viable, robust and reliable software by ensuring that projects are completed satisfactorily, on time, and within budget ,
PEO-3	Work as a member of a team and communicate effectively across team members, to be equipped to be competent in the field of computer science and be equipped to act as a business administrators or as administrators in public, private and government organisations or become an entrepreneur.
PEO-4	understand environmental, legal, cultural, social, ethical, public safety issues work along with engineering, medical, ICT professionals and scientists to assist them in their research and development work after further training

Program Outcomes (POs)

PO 1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of computer science that form a part of the graduate programme Master of Science in Computer Science

PO 2: Scientific reasoning: Ability to analyse, and understand concepts in computer science, and explain the theories behind computer science. critically evaluate ideas, logical reasoning and experiences in programming, software development and application development.

PO 3: Problem solving: Capacity to extrapolate and apply competencies to solve different kinds of non-familiar problems, such as solving of real life problems through computing, provide Solutions to computing problems, analyze existing algorithms of different applications, design and develop new algorithms, operate various commercial software tools to solve scientific and business problems

PO 4: Environment and Sustainability: Understand the issues of environmental contexts and sustainable development and provide solutions for the same using domain knowledge in Computer science.

PO 5: Research-related skills: Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation in current technologies.

PO 6: Ethics: Conduct as a responsible citizen by recognizing different value systems and understand and **accept responsibility of the moral dimensions and take** decisions which conform to cultural, environmental, sustainability and ethical issues for them.

PO 7: Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

PO 8: Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups

PO 9: Self-directed and Life-long Learning: Acquire the ability to engage in independent and **life-long learning** in the broadest context socio-technological changes.

Programme Specific Outcomes (PSO)

After successful completion of the programme, the graduates will be able to

1. Apply the latest trends in technology to design, develop and test software applications for specific needs.
2. Explore the concepts and theories behind computer science to develop innovative software applications.
3. Instill life-long learning skills through the development of a research environment and higher educational opportunities

MS in Computer Science

(With Specialization in Data Science and Analytics)

SCHEME OF INSTRUCTION

FIRST SEMESTER

Sl. No	Code	Title	HC/SC/OE	Credit Pattern			Credits	Work ing Hours
				L	T	P		
1.	MS17CS101	Multivariable Calculus	HC	3	1	0	4	5
2.	MS17CS102	Object Oriented Programming with JAVA	HC	3	0	1	4	5
3.	MS17CS103	Data Mining and Knowledge Discovery	HC	3	1	0	4	5
4.	MS17CS104	Big Data Management	HC	3	0	1	4	5
5.	MS17CS105	Advanced Networks	HC	3	1	0	4	5
6.	MS17CS106	Probability & Statistics	HC	3	0	1	4	5
7.	MS17CS117	Distributed Algorithms Design	SC	3	1	0	4	5
	MS17CS127	Advanced Operating Systems						
	MS17CS137	Image Processing						
Total Credits				21	4	3	28	35

SECOND SEMESTER

Sl. No	Code	Title	HC/SC/OE	Credit Pattern			Credits	Work ing Hours
				L	T	P		
1.	MS17CS201	Machine Learning algorithms	HC	3	1	0	4	5
2.	MS17CS202	Data Analytics using Python	HC	3	0	1	4	5
3.	MS17CS203	Cloud Computing	HC	3	1	0	4	5
4.	MS17CS214	Introduction to Web Technologies	SC	3	0	1	4	5
	MS17CS224	System Modelling and Simulation						
	MS17CS234	Information Storage Management						
5.	MS17CS215	Big Data and NoSQL	SC	3	0	1	4	5
	MS17CS225	Social Network Analytics						
	MS17CS235	Internet of Things						
6.	MS17CS216	Pattern Recognition	SC	3	1	0	4	5
	MS17CS226	Bio-Informatics						
	MS17CS236	Natural Language Processing						
7.	MS17CS217	Big Data Security	SC	3	1	0	4	5
	MS17CS227	Deep Learning						
	MS17CS237	Data ware housing and Business Intelligence						
Total Credits				21	4	3	28	35

THIRD SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern			Credits	Working Hours
				L	T	P		
1.	MS17CS301	Open Elective	OE	3	1	0	4	5
2.	MS17CS312	Mobile n/w and computing	SC	3	1	0	4	5
	MS17CS322	Object Oriented Software Engineering						
	MS17CS332	IT Security						
3.	MS17CS313	Multivariate Methods for Data Analysis	SC	3	1	0	4	5
	MS17CS323	Stochastic Decision Science						
	MS17CS333	Advanced Web Technologies						
4.	MS17CS304	Minor Project / Internship	HC	1	1	6	8	15
Total Credits				10	3	6	20	25

FOURTH SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern			Credits	Working Hours
				L	T	P		
1.	MS17CS401	Project Work and Dissertation	HC	2	4	14	20	38
Total Credits				2	4	14	20	38

Credit Summary

Semester	Credits
First	28
Second	28
Third	20
Fourth	20
Total	96

Semester	Hard Core (HC)	Fundamental Core (FC)	Soft Core (SC)	Open Elective (OE)	Total Credits
I	24	-	4	-	28
II	14	-	14	-	28
III	8	-	8	4	20
IV	20	-	-	-	20
Total Credits for Programme					96

MS in Computer Science

(With Specialization in Data Science and Analytics)

DETAILED SYLLABUS

FIRST SEMESTER

Sl. No	Code	Title	HC/ SC/ OE	Credit Pattern			Credits	Work ing Hours
				L	T	P		
1.	MS17CS101	Multivariable Calculus	HC	3	1	0	4	5
2.	MS17CS102	Object Oriented Programming with JAVA	HC	3	0	1	4	5
3.	MS17CS103	Data Mining and Knowledge Discovery	HC	3	1	0	4	5
4.	MS17CS104	Big Data Management	HC	3	0	1	4	5
5.	MS17CS105	Advanced Networks	HC	3	1	0	4	5
6.	MS17CS106	Probability & Statistics	HC	3	0	1	4	5
7.	MS17CS117	Distributed Algorithms Design	SC	3	1	0	4	5
	MS17CS127	Advanced Operating Systems						
	MS17CS137	Image Processing						
Total Credits				21	4	3	28	35

DETAILED SYLLABUS

FIRST SEMESTER

Course Code	Multivariable Calculus	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS101		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- This course covers differential, integral and vector calculus for functions of more than one variable.
- These mathematical tools and methods are used extensively in the physical sciences, engineering, economics and computer graphics

Course Outcomes:

On successful completion of this course; the student will be able to:

- An ability to construct free-body diagrams.
- An understanding of the analysis of distributed contents.
- Calculate and interpret derivatives in up to three dimensions.
- Integrate functions of several variables over curves and surfaces.

Course Contents:

Unit – I-Matrices and Vectors

15 Hours

Matrices, Matrices Operations, Related Matrices, Determinants, Properties of Determinants, Solution of Linear System of Equations, Vectors, Scalar or Dot Product, Vector or Cross product, Scalar Product of Three Vectors, Vector Product of Three Vectors, Differentiation of Vectors, Velocity and Acceleration.

Unit – II - Partial Differentiation and its Applications

15 Hours

Functions of Two or More Variable, Partial Derivatives, Homogeneous Functions, Total Derivative, Geometrical Interpretation, Taylor's Theorem for functions of Two Variables, Maxima and Minima of Functions of Two Variables, Lagrange's Method of Undetermined Multipliers. Scalar and Vector Point Functions, Del Applied to Scalar Point Functions – Gradient, Del applied Twice to Point Functions, Del Applied to Products of Point Functions.

Unit – III - Double Integrals and its Applications

15 Hours

Double Integrals, Change of Order of Integration, Double Integrals in Polar Coordinates; Area enclosed by Plane Curves, Integration of Vectors, Line Integral, Surface, Green's Theorem in the Plane, Stoke's Theorem.

Unit – IV - Triple Integrals and its Applications

15 Hours

Triple Integrals, Volumes of Solids, Change of Variables, Area of a Curved Surface, Calculation of Mass, Centre of Gravity, Centre of Pressure, Volume Integral, Green's Theorem, Irrotational Fields, Solenoidal Fields, Orthogonal Curvilinear Coordinates, Cylindrical Coordinates, Spherical Polar Coordinates.

Recommended Learning Resources:

- 1) B S Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015, ISBN No: 978-81-7409-195-5
- 2) Calculus, Early Transcendentals Plus New May Math Lab by William Briggs, Lyle Cochran, and Gillet Pearson, Addison-Wesley, 2014.
- 3) Edwards, Henry C., and David E. Penney, Multivariable Calculus. 6th ed. Lebanon, IN: Prentice Hall, 2002. ISBN: 9780130339676.

Course Code	Object Oriented Programming with Java	Duration (Weeks)	Course Type	L	T	P	C	Hrs/Wk
MS17CS102		16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Understand fundamentals of object-oriented programming in Java, including defining Classes, invoking methods, using class libraries, exception handling etc.
- Solve problems using object-oriented paradigm
- Develop applications using threads and applet programming.
- Understand Java Database Connectivity.

Course Outcomes

On successful completion of this course, the student will be able to:

- Implement Java classes from specifications.
- Effectively create and use objects from predefined class libraries.
- Use interfaces, inheritance, and polymorphism as programming techniques.
- Use exceptions and multithreading.

Unit-I- Introduction to JAVA Programming

15 Hours

An overview of Java, Internal Details of JVM Difference between JDK, JRE and JVM, Data types, variables, type conversion, casting, arrays, operators, arithmetic, bitwise, relational, Boolean, precedence, Control Statements.

Unit-II- Introduction to classes in java and members of the class

15 Hours

Classes, abstract classes – the Object class, methods, constructors, Java static Method, this, Super and final keyword, dynamic binding overloading, inheritance, Packages, interfaces, String handling.

Unit-III- AWT and Applets

15 Hours

Exception handling - Input/output Java streams - Threads - Abstract Windowing Toolkit - Overview, working with Windows, Graphics, Text, Images - AWT Controls - Applets - Scripts - Exploring Java

Unit-IV- Swings and JDBC**15 Hours**

Laying out components - Introducing Java Foundation Classes - Swing Packages – Swing – Introduction to JDBC- Type of Drivers- connecting and performing different operation on database.

Recommended Learning Resources:

1. Patrick Naughton and Herbert Schildt, “Java: The Complete Reference”, Tata McGraw-Hill, New Delhi, 1997.
2. Aaron Walsh and John Fronckowick, “Java Bible, Programming Version 2”, IDG Books Worldwide, Inc. 2000.
3. Balagurusamy E, “Programming with JAVA”, TMG, 2007
4. Deitel H.M, Deital P.J,”Java How to program”, Sixth Edition, Prentice Hall India, 2005.
5. ISBN: 0131483986

JAVA PROGRAMMING LAB**Part A**

1. Demonstrate various I/O streams in java.
2. Demonstrate the Reader/Writer classes in java.
3. Demonstrate the multithreading concept by implementing Runnable interface.
4. Demonstrate the multithreading concept by extending Thread class.
5. Write an applet program and using paint function make some graphics.
6. Write a program to demonstrate the usage of different Layouts in java.
7. Write a java program to demonstrate various GUI components in java (AWT / SWING) with appropriate Event Handling.
8. Creating simple JDBC application

Part – B

Design a simple windows application using swings and MYSQL by following the constraints listed below

- Should be a team project with max of two
- All the layouts should be used in the entire project
- All the validations are must
- Packages, interfaces, inheritance and Exception handling concepts must be used

Course Code	Data Mining and Knowledge Discovery	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS103		16	HC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Learn data analysis techniques through Data Mining.
- Understand Data mining techniques and algorithms.
- Comprehend the data mining environments and application.

Course Outcomes

On successful completion of this course, the student will be able to:

- Compare various conceptions of data mining as evidenced in both research and application.
- Characterize the various kinds of patterns that can be discovered by association rule mining.
- Evaluate mathematical methods underlying the effective application of data mining.
- Understand the process of Knowledge discovery

Course Contents

UNIT-I- Introduction to Data Mining

15 Hours

Basics of Data Mining & Knowledge Discover , The Six Phases of Data Mining, Data mining Tasks, Data mining Case studies ,Statistical Perspective on data mining – Similarity Measures, Data Cleaning, Handling Missing Data, Data Transformations

UNIT-II - Classification

15 Hours

Supervised and Unsupervised Learning, Methodology for Supervised Learning, Introduction – Statistical – based algorithms - Distance – based algorithms – Decision tree - based algorithms - Neural network – based algorithms

UNIT-III-Clustering

15Hours

Introduction – Similarity and Distance Measures – Outliers, Partitional Methods, Hierarchical Methods, Density Based Methods. Features of Cluster Analysis.

UNIT-IV-Association Rule Mining

15 Hours

Association rules: Introduction - Large item sets - Basic algorithms: Apriori algorithm – Generation of Association rules, Sampling Algorithm – Partitioning algorithms, Measuring the quality of rules.

Data Mining Applications: Data Mining for Financial Data Analysis - Data Mining for the Retail Industry - Data Mining for the Telecommunication Industry - Data Mining for Intrusion Detection.

Recommended Learning Resources:

1. Daniel.T.Larose Knowledge discovery, An Introduction to Data Mining, Wiley Publishers, 2014
2. Margaret H. Dunham, “Data mining introductory and advanced topics”, Pearson education, 2003. (Units 2,3 and 4)
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Addison Wesley, 2005.
4. G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI, New Delhi, 2009.

Course Code	Big Data management	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS104		16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- This course brings together several key big data technologies used for storage analysis and manipulation of data..
- Prepare a sample project in Hadoop API.

Course Outcomes

On successful completion of this course, the student will be able to:

- Categorize and summarize Big Data and its importance.
- Differentiate various Big data technologies like Hadoop, MapReduce, Pig, Hive, Hbase and No- SQL.
- Recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive,and No-SQL
- Apply tools and techniques to analyze Big Data.

Course Contents

UNIT-I-Introduction to Big Data

15 Hours

Introduction – distributed file system – Big Data and its importance, Four Vs, Types of Data structured, unstructured and Semi-structured data. Drivers for Big data, Big data applications. Industry examples of Big Data.(T1 and distributed computing book).

UNIT-II- Big Data Analytics

15 Hours

Big data analytics, Business Intelligence and Big Data, Types of Big data Analytics, Use cases– Crowd Sourcing Analytics – Text analytics. Cloud and Big Data, Information Management.

UNIT-III- Processing Big Data

15 Hours

Integrating disparate data stores - Mapping data to the programming framework- Connecting and extracting data from storage - Transforming data for Processing.
Map Reduce, Map Reduce examples, The Building Blocks of Hadoop Map Reduce, Creating the components of Hadoop Map Reduce jobs, Understanding inputs and outputs of MapReduce - Data Serialization. Hadoop's Parallel World, Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop,

UNIT-IV-HDFS and HIVE

15 Hours

Hadoop Architecture, Hadoop Storage: HDFS. Investigating the Hadoop Distributed File System
Selecting appropriate execution modes: local, pseudo-distributed, fully distributed
Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating.

Recommended Learning Resources:

1. Ambiga Dhiraj , Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Business”, 1st Edition, , Wiely CIO Series, 2013
2. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, 1st Edition, IBM Corporation, 2012.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
4. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
5. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012.
6. Tom White, “HADOOP: The definitive Guide” , O Reilly 2012.

Hadoop Programming Lab

1. Consider a company of electronic goods. The company is maintaining the excel file of the goods sold in every month. Find out Number of Products Sold in Each Country.

2. Using movie lens data

- i. List all the movies and the number of ratings
- ii. List all the users and the number of ratings they have done for a movie
- iii. List all the Movie IDs which have been rated (Movie Id with at least one user rating it)
- iv. List all the Users who have rated the movies (Users who have rated at least one movie)
- v. List of all the User with the max, min, average ratings they have given against any movie
- vi. List all the Movies with the max, min, average ratings given by any user

3. MapReduce

- i. Create a JOB and submit to cluster ii.
Track the job information
- ii. Terminate the job
- iii. Counters in MR Jobs with example
- iv. Map only Jobs and generic map examples
Distributed cache example
- v. Combiners, Secondary sorting and Job chain examples

4. WordCount

Let’s understand the problem through a sample text file content:

“Hello everyone this is a sample dataset. You need to print the word count of particular words in this dataset.”

Your MapReduce program should process this text file and should provide output as follows:

Output

Word Word Count

a 1 (As the word ‘a’ occurred only once)

this 2 (As the word ‘this’ occurred twice)

5. WordSizeWordCount Program

Apply your MapReduce programming knowledge and write a MapReduce program to process two text files. You need to calculate the size of each word and count the number of words of that size in the text file.

The dataset for this problem is the text file ‘alphabets’ available in your LMS.

Problem statement

Let’s understand the problem through a sample text file content:

“Hello everyone this is a sample dataset. Calculate the word size and count the number of words of that size in this text file.”

Your MapReduce program should process this text file and should provide output as

follows: Sample Output

Word Size	Word Count
1	1 (As the word of size 1 is: a)
2	4 (As the words of size 2 are: is, of, of, in)
3	3 (As the words of size 3 are: the, and, the)
4	6 (As the words of size 4 are: this, word, size, that, size)

Course Code	Advanced Networks	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS105		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Make students build an understanding of the fundamental concepts of computer networking;
- Make students to become Familiar with the basic taxonomy and terminology of the computer networking area;
- Introduce the students to advanced networking concepts, preparing the student for entry Advanced courses in computer networking;
- Allow the students to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Course Outcomes:

On successful completion of this course, the student is expected to be able to:

- Independently understand basic computer network technology;

- Understand and explain Data Communications System and its components;
- Identify the different types of network topologies and protocols;
- Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer;
- Identify the different types of network devices and their functions within a network;
- Become familiar with the basic protocols of computer networks, and how they can be used to assist in network design and implementation.

Course Contents:

Unit-I-Computer Networks and the Internet

15 Hours

What Is the Internet? Network Edge; Network Core; Delay, Loss, and Throughput in Packet-Switched Networks; Protocol Layers and Their Service Models.

Application Layer: Principles of Network Applications; Web and HTTP; File Transfer: FTP; Electronic Mail in the Internet; DNS—The Internet’s Directory Service; Peer-to-Peer Applications; Socket Programming: Creating Network Application.

Unit-II-Transport Layer

15Hours

Introduction and Transport-Layer Services; Multiplexing and Demultiplexing; Connectionless Transport: UDP; Principles of Reliable Data Transfer; Connection-Oriented Transport: TCP; Principles of Congestion Control; TCP Congestion Control

The Network Layer: Introduction; Virtual Circuit and Datagram Networks; what’s Inside a Router? The Internet Protocol (IP): Forwarding and Addressing in the Internet; Routing Algorithms; Routing in the Internet; Broadcast and Multicast Routing

Unit-III-The Link Layer: Links, Access Networks, and LANs

15 Hours

Introduction to the Link Layer; Error-Detection and -Correction Techniques; Multiple Access Links and Protocols; Switched Local Area Networks; Link Virtualization: A Network as a Link Layer; Data Center Networking; Retrospective: A Day in the Life of a Web Page Request

Wireless and Mobile Networks

15 Hours

Introduction; Wireless Links and Network Characteristics; WiFi: 802.11 Wireless LANs; Cellular Internet Access; Mobility Management: Principles; Mobile IP; Managing Mobility in Cellular Networks; Wireless and Mobility: Impact on Higher-Layer Protocols

Unit-IV-Security in Computer Networks

15 Hours

What Is Network Security? Principles of Cryptography; Message Integrity and Digital Signatures; End-Point Authentication; Securing E-Mail; Securing TCP Connections: SSL; Network-Layer Security: IPsec and Virtual Private Networks; Operational Security: Firewalls and Intrusion Detection Systems

Network Management: What Is Network Management? The Infrastructure for Network Management; The Internet-Standard Management Framework.

Recommended Learning Resources:

1. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, . Addison- Wesley, 6/E edition, 2013.
2. Nader F. Mir, Computer and Communication Networks, Pearson Education, 2007.
3. Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition, Tata McGraw Hill, 2007.

4. Andrew S. Tanenbaum , Computer Networks , , Prentice Hall, 5th edition, 2011.
5. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, . Morgan Kaufmann, 5th edition, 2011.

Course Code	Probability & Statistics	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS106		16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Know the different Sampling Techniques used in Big data and related areas
- Introduce Random variables, Random vectors and distributions
- Learn the statistical procedures most often used by practicing engineers.
- Understand Forecasting methods and apply for business applications.

Course Outcomes

On successful completion of this course, the student will be able to:

- Deal with the different Sampling Techniques used in Big data and related areas
- Design Random variables, Random vectors and distributions
- Learn the statistical procedures most often used by practicing engineers.
- Understand Forecasting methods and apply for business applications

Course Contents

UNIT-I-Statistics

15 Hours

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation -

Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode,

Median,

Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.

UNIT-II- Probability and Hypothesis Testing

15 Hours

Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1& 2 tailed test, uses of t-distribution, F-distribution, χ^2 distribution.

UNIT-III-Predictive Analytics

15 Hours

Predictive modelling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, Rank correlation coefficient, Multiple correlation, Least square, Curve fitting and goodness of fit.

UNIT– IV-Time Series Forecasting And Design Of Experiments

15 Hours

Forecasting Models for Time series: MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classification, ANOVA, Latin square, Factorial Design.

Recommended Learning Resources:

1. Chris Eaton, Dirk Deroos, Tom Deutsch et al., “Understanding Big Data”, McGraw Hill, 2012.
2. Alberto Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
3. Eric Siegel, Thomas H. Davenport, “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, Wiley, 2013.
4. James R Evans, “Business Analytics – Methods, Models and Decisions”, Pearson 2013.
5. R. N. Prasad, Seema Acharya, “Fundamentals of Business Analytics”, Wiley, 2015.
6. S M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Foundation, 2011.
7. David Hand, Heiki Mannila, Padhria Smyth, “Principles of Data Mining”, PHI 2013.
8. Spyros Makridakis, Steven C Wheelwright, Rob J Hyndman, “Forecasting methods and applications”, Wiley 2013(Reprint).
9. David Hand, Heikki Mannila, Padhraic Smyth, “Principles of Data mining”, PHI 2013.
10. <http://cran.r-project.org/doc/manuals/R-intro.html>
11. W.N. Venables, D.M Smith, “An introduction to R”,
12. R in Nutshell , O Reilly,

Probability in R

Tossing a coin

The probability of getting a Heads or a Tails on a coin toss is both 0.5. We can use R to simulate an experiment of flipping a coin a number of times and compare our results with the theoretical probability. First let x the convention:

0 = Tails and 1 = Heads

1. Use R to simulate an experiment of tossing a coin 100 times. Print the relative histogram as above with your your name on it.
2. Find the relative frequency of a Tail and Head in your experiment and fill in the table on the next page.
3. Repeat 2 for tossing a coin 500 times (do not print histogram).

Rolling dice

The probability of getting a number between 1 to 6 on a roll of a die is $1/6 = 0.1666667$.

As above we can use R to simulate an experiment of rolling a die a number of times and compare our results with the theoretical probability. We can use the following command to tell R to roll a die 20 times:

4. Use R to simulate an experiment of rolling a die 200 times. Print the relative histogram and write your name on it.
5. Find the relative frequency of the numbers 1 to 6 in your experiment and fill in the table on

Course Code	Course Title	Duration	Course Type	L	T	P	C	Hrs./Wk.
MS17CS117	Distributed Algorithms Design	16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Provide an overview of distributed computing environment
- Describe the core ideas behind modern coordination and communication paradigms and distributed data structures;
- Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs;
- Realize the basic principles and also the best practice engineering techniques of concurrent and distributed computing;
- Present techniques to formally study the safety and progress properties of concurrent and distributed algorithms

Course Outcomes

On successful completion of this course; the student will be able to:

- Make students to understand the concepts behind distributed algorithms
- List and classify various distributed algorithms
- Assess the applicability of distributed algorithms to a particular circumstance.
- Familiar with various distributed set operations

Course Contents

UNIT I - Introduction to Algorithms

15 Hours

Introduction to Preliminaries - Design and Analysis Fundamentals - Mathematical Tools for Algorithm Analysis - Trees and Applications to Algorithms - More on Sorting Algorithms - Probability and Average Complexity of Algorithms.

UNIT II - Design Strategies**15 Hours**

Major Design Strategies - The Greedy Method – Divide and Conquer - Dynamic Programming – Backtracking and Branch and Bound.

UNIT III - Graph and Network Algorithms**15 Hours**

Graph and Network Algorithms - Graphs and Digraphs - Minimum Spanning Tree and Shortest-Path Algorithms - Graph Connectivity and Fault-Tolerance of Networks - Matching and Network Flow Algorithms.

UNIT IV - Parallel and Distributed Algorithms**15 Hours**

Parallel and Distributed Algorithms - Introduction to Parallel Algorithms and Architectures – Parallel Design Strategies - Internet Algorithms -Distributed Computation Algorithms - Distributed Network Algorithms.

Recommended Learning Resources :

1. Design and Analysis of Distributed Algorithms, First Edition, Nicola Santoro, Wiley Publications, 2006.
2. Nancy Ann Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, 1996
3. . Kenneth A. Berman, Jerome L. Paul , “Algorithms: Sequential, Parallel, and Distributed”, Amazon Bestsellers, 2004.
4. Russ Miller, Laurence Boxer, “Algorithms Sequential and Parallel: A Unified Approach”, Prentice Hall, 1 edition, 1999.
5. Dimitri P. Bertsekas and John N. Tsitsiklis, “Parallel and Distributed Computation: Numerical Methods”, Prentice Hall, 1989.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS127	Advanced Operating Systems	16	SC	3	0	1	4	5

Course Objectives:

The objectives of this course are to:

- Introduce the overview of operating system, process description and its control.
- Study T h r e a d s , SMP, and microkernel and virtual memory concepts.
- Provide systematic and comprehensive treatment of operating system;
- Provide a strong foundation in distributed resource management components. viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols;

Course Outcomes:

On successful completion of this course; the student will be able to:

- Demonstrate a fundamental knowledge of Windows, Linux, Unix, TinyOS, description and its control

- Impart the knowledge about Threads, SMP, microkernel and virtual memory concepts.
- Demonstrate a fundamental knowledge of the various resource management techniques for distributed systems;
- Gain expertise in the security and kernel organization

Course Contents:

Unit-I- Multiple Processor Systems

18 Hours

MULTIPROCESSORS: Definition, Advantages, Classification, Multiprocessor Interconnections, Types of Multiprocessor Operating Systems, Multiprocessor OS Functions and Requirements, OS Design and Implementing Issues, Multicomputer, Virtualization, Multiprocessor Scheduling.

Unit-II- Distributed Operating System

14 Hours

Definition, Need, Models of Distributed Systems, Distributed Message Passing, Remote Procedure calls, Algorithms for Distributed Processing.

Unit-III- Multimedia Operating Systems

14 Hours

Introduction to Multimedia; Multimedia files: Video Encoding, Audio Encoding; Video compression: The JPEG Standard, The MPEG Standard; Audio compression; Multi-media process Scheduling.

Unit-IV- Embedded System & Network Operating System

14 Hours

Embedded System: Definition, Need, Characteristics, Types of Embedded OS- Tiny OS; Network OS: Definition, Features of NOS, Types Of NOS, Windows Server VS Linux Server.

Recommended Learning Resources:

- 1) "Modern Operating System" By Andrew S Tanenbaum, 3rd ed (ch 7, 8)
- 2) "Operating Systems" concepts and design By Milan Milinkovic, 2nd ed
- 3) "Operating Systems" Internals and design Principles By William Stallings ,6th ed
- 4) Springer, Springer transaction for advance in Distributed computing and middleware.
- 5) IEEE, IEEE transaction for Real time operating system.
- 6) ACM, ACM transaction for embedded operating system

Course Code	Image Processing	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS137		16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Introduce the special and frequency domain processing
- Make students to become Familiar with Segmentation and edge detection
- Explain the basics of digital images, noise models, spatial domain filters
- Describe frequency domain filters, basic image analysis --- segmentation, edge detection, and corner detection
- Teach morphological operations and texture analysis
- Explain processing of color images and image compression techniques

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand special and frequency domain processing
- Understand image modalities, sensing, acquisition, sampling, and quantization, image noise models
- Analyze spatial filter operations, frequency domain transformations
- Implement and Apply segmentation algorithms, edge detection techniques, corner and interest point detection algorithms and morphological operations

Course Contents

Unit-I - Spatial Domain Processing

15 Hours

Introduction to image processing, imaging modalities, image file formats, image sensing and acquisition, image sampling and quantization. Noise models, spatial filtering operations, histograms, smoothing filters. Sharpening filters. Fuzzy techniques for spatial filtering, spatial filters for noise removal

Unit-II - Frequency Domain Processing

15 Hours

Frequency domain, Review of Fourier Transform (FT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT), filtering in frequency domain, image smoothing, image sharpening, selective filtering, frequency domain noise filters, wavelets, Haar Transform, multi-resolution expansions, wavelet transforms, wavelets based image processing.

Unit-III - Segmentation and Edge Detection

15 Hours

Thresholding techniques, region growing methods, region splitting and merging, adaptive thresholding, threshold selection, global valley, histogram concavity, edge detection, template matching, gradient operators, circular operators, differential edge operators, hysteresis thresholding, Canny operator,

Laplacian operator, active contours, object segmentation.

Unit-IV - Interest Points and Texture

15 Hours

Corner and interest point detection, template matching, median filter based detection, Harris interest point operator, corner orientation, local invariant feature detectors and descriptors, texture & texture analysis.

Image Compression: Image Compression, redundancy in images, coding redundancy, irrelevant information in images, image compression models, basic compression methods, digital image watermarking.

Recommended Learning Resources:

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
2. W. Burger and M. Burge, "Digital Image Processing: An Algorithmic Introduction using Java", Springer, 2008.
3. John C. Russ, "The Image Processing Handbook", Sixth Edition, CRC Press, 2011.
4. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Third Edition, Pearson, 2008.
5. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
6. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packet Publishing, 2012.
7. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
8. ACM Transactions on Modeling and Computer Simulation (TOMACS)
9. IEEE transaction on Image Processing
10. ACM Transactions on Graphics

Image Processing Lab

The Lab component will be decided by the faculty. The lab can be done either using MATLAB/SCI LAB.

SECOND SEMESTER

Sl. No	Code	Title	HC/SC/OE	Credit Pattern			Credits	Working Hours
				L	T	P		
1.	MS17CS201	Machine Learning algorithms	HC	3	1	0	4	5
2.	MS17CS202	Data Analytics using Python	HC	3	0	1	4	5
3.	MS17CS203	Cloud Computing	HC	3	1	0	4	5
4.	MS17CS214	Introduction to Web Technologies	SC	3	0	1	4	5
	MS17CS224	System Modelling and Simulation						
	MS17CS234	Information Storage Management						
5.	MS17CS215	Big Data and NoSQL	SC	3	0	1	4	5
	MS17CS225	Social Network Analytics						
	MS17CS235	Internet of Things						
6.	MS17CS216	Pattern Recognition	SC	3	1	0	4	5
	MS17CS226	Bio-Informatics						
	MS17CS236	Natural Language Processing						
7.	MS17CS217	Big Data Security	SC	3	1	0	4	5
	MS17CS227	Deep Learning						
	MS17CS237	Data ware housing and Business Intelligence						
Total Credits				21	4	3	28	35

Course Code	Machine Learning algorithms	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS201		16	HC	3	1	0	4	5

Course Objectives:

The objectives of this course are to

- Introduce the fundamental problems of machine learning;
- Impart basic knowledge of the key algorithms and theory that form the foundation of machine learning;
- Provide understanding of techniques, mathematical concepts, and algorithms used in machine learning to facilitate further study in this area;
- Provide understanding of the limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms;

Course Outcomes:

On successful completion of this course, the student will be able to:

- Understand the basic theory underlying machine learning;
- Formulate machine learning problems corresponding to different applications;
- Understand the principles, advantages, limitations and possible applications of machine learning;
- Apply machine learning algorithms to solve classification, pattern recognition, and optimization and decision problems of moderate complexity.

Course Contents:

Unit-I - Introduction

15 Hours

Machine Learning; Machine Learning Foundations, Overview – applications - Types of machine learning, Basic concepts in machine learning Examples of Machine Learning, Applications - Linear Models for Regression; Linear Basis Function Models; The Bias-Variance Decomposition Bayesian Linear Regression, Bayesian Model Comparison

Unit-II - Supervised Learning

15 Hours

Linear Models for Classification; Discriminant Functions; Probabilistic Generative Models; Probabilistic Discriminative Models; Bayesian Logistic Regression; Decision Trees; Classification Trees- Regression Trees; Pruning; Neural Networks; Feed-forward Network Functions, Error Back propagation; Regularization, Mixture Density and Bayesian Neural Networks, Kernel Methods Dual Representations; Radial Basis Function Networks; Ensemble methods- Bagging- Boosting

Unit-III - Unsupervised Learning**15 Hours**

Clustering- K-means - EM - Mixtures of Gaussians, The EM Algorithm in General -Model selection for latent variable models -; high-dimensional spaces -- The Curse of Dimensionality -Dimensionality Reduction, Factor analysis; Principal Component Analysis - Probabilistic PCA; Independent components analysis

Unit-IV- Probabilistic Graphical Models**15 Hours**

Directed Graphical Models, Bayesian Networks, Exploiting Independence Properties, From Distributions to Graphs, Examples -Markov Random Fields - Inference in Graphical Models Learning -Naive Bayes classifiers-Markov Models; Hidden Markov Models, Inference, Learning Generalization, Undirected graphical models- Markov random fields; Conditional independence properties - Parameterization of MRFs - Examples - Learning, Conditional random fields (CRFs) Structural SVMs

Recommended Learning Resources:

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
3. EthemAlpaydin, Introduction to Machine Learning, Prentice Hall of India, 2005.
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
5. Hastie, Tibshirani, Friedman, The Elements of Statistical Learning (2nd ed.), Springer, 2008.
6. Stephen Marsland, Machine Learning –An Algorithmic Perspective, CRC Press, 2009.
7. IEEE Transactions on Pattern Analysis and Machine Intelligence
8. Journal of Machine Learning Research , 4 (2003): 971-1000.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS202	Data Analytics using Python	16	HC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Understanding the basic concepts of Python
- Preparing and pre-processing data
- Understanding the data aggregation and grouping concepts
- Leveraging web scraping
- Visualizing the results of analytics effectively

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the basics concepts of python
- Prepare and pre-process the data
- Understand the data aggregation and grouping concepts
- Leverage web scraping Visualize the results of analytics effectively

Course Contents

Unit-I-Introduction of Python

15 Hours Programming

Basics and Strings, Numbers and Operators, Variables — Names for Values, Functions, Classes and Objects, Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing

Unit-II-Getting Started with pandas

15 Hours Introduction

to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Handling Missing Data , Hierarchical Indexing

Unit-III-Data Loading, Storage, and File Formats

15 Hours Reading

and Writing Data in Text Format, Binary Data Formats, Interacting with HTML and Web APIs, Interacting with Databases, Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.

Unit-IV-Data Wrangling: Clean, Transform, Merge, Reshape

15 Hours

GoupBy Mechanics – Data Aggregation – Groupwise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting, Data Acquisition by Scraping web applications – Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors.

Recommended Learning Resources:

McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc."

Payne, J. (2010). Beginning Python: Using Python 2.6 and Python 3.1. Wrox Press Ltd..

Michael Urban Joel Murach, murach's Python Programming, Shroof publishers, 2017.

Data Analytic using Python Lab

1. Write a Python program to create and display a one-dimensional array-like object containing an array of data using Pandas module.
2. Write a Python program to convert a Panda module Series to Python list and it's type.
3. Write a Python program to add, subtract, multiple and divide two Pandas Series.
4. Write a Python program to get the largest integer smaller or equal to the division of the inputs.
5. Write a Python program to create and display a DataFrame from a specified dictionary data which has the index labels.
6. Write a Python program to display a summary of the basic information about a specified DataFrame and its data.
6. Write a Python program to get the first 3 rows of a given DataFrame.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS203	Cloud Computing	16	HC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Introduce the broad perceptives of cloud architecture and model
- Understand the concept of Virtualization and design of cloud Services
- Be familiar with the lead players in cloud.
- Understand the features of cloud simulator
- Apply different cloud programming model as per need.
- Learn to design the trusted cloud Computing system

Course Outcomes

On successful completion of this course, the student will be able to:

- Compare the strengths and limitations of cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Apply suitable virtualization concept.
- Choose the appropriate cloud player, Programming Models and approach.
- Address the core issues of cloud computing such as security, privacy and interoperability

Course Contents

Unit-I-Fundamentals of Cloud Computing

15 Hours

Cloud computing at a glance, The vision of cloud computing, Defining a cloud, A closer look, Historical developments, Building cloud computing environments Application development, Computing platforms and technologies Principles of Parallel and Distributed Computing, Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing- ,Scaling and types of scaling, Service-oriented computing.

Unit-II-Fundamental concept and Models

15 Hours

Basics of Virtualization, Characteristics of virtualized environments, Taxonomy of virtualization techniques, - Types of Virtualization, Virtualization and cloud computing, Technology examples, Xen: paravirtualization, VMware: full virtualization –Just introduction.

Unit-III-Cloud Infrastructure Mechanisms and Architecture

15 Hours

The cloud reference model, Cloud Delivery Models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), Comparing Cloud Delivery Models, Cloud

Deployment Models: Public Clouds, CommUnity Clouds, Private Clouds, Hybrid Clouds, Fundamentals of Cloud Architecture, Introduction to Cloud Software Environments , Architecture of Eucalyptus, Open Stack, Aneka.

Unit-IV-Cloud Applications

15 Hours

Scientific applications, Healthcare: ECG analysis in the cloud, Biology: protein structure prediction, Geoscience: satellite image processing, Business and consumer applications, CRM and ERP, Social networking, Deploying applications in the cloud, open cloud platforms AWS,GAE.

Recommended Learning Resources:

1. Rajkumar Buyya, Christian Vechiolla, Thamarai Selvi, “**Mastering Cloud Computing**”, Elsevier publications, 2013, USA
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, “**Cloud Computing: Principles and Paradigms**”, Wiley, India .
3. Kai Hwang, Geoffrey C Fox, Jack G Dungaree, “Distributed and Cloud Computing, From ParallelProcessing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
4. Thomas Erl, Zaigham,Mahmood, Ricardo Puttini, “ **Cloud Computing:Concepts, Technology & Architecture**”, Prentice Hall/Pearson.
5. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation Management,and Security”, CRC Press, 2010.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH,2009.

Course Code	Introduction to Web Technologies	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS214		16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Learn core technical skills necessary for a complete understanding of front-end web development, including HTML 5 and CSS, JavaScript, DOM.
- Understand rich internet applications that use most recent client-side programming technologies.
- Understand client-side validations using Java Script.

Course Outcomes

On successful completion of this course, the student will be able to:

- Gain knowledge on HTML(5)+CSS programming skills.
- Develop basic HTML, CSS and Java script programming.
- Design and implement web pages.
- Create a site that has a consistent outlook and its functionalities work on different platforms.

Course Contents

Unit-I - Introduction

15 Hours

The World Wide Web, WWW Architecture, Web Search Engines, Web crawling, Web indexing, Web Searching, Search engines optimization and limitations, Introduction to the semantic web.

Basic HTML: Structure of HTML, Comments, Blocks of text, Paragraphs, Line breaks, Horizontal rules, Quoted paragraphs,. Dividing text into blocks, Pre-formatted text, Logical tags, Fonts, Headers, Font, Font styles, Character entities, Links, Destination, Lists, Images, Tables, Forms, Form elements

Unit-II-HTML 5

15Hours

Detecting HTML 5 features – Canvas, video, local storage, web workers, offline applications, geolocation, placeholders, and input types. What does it all mean –doctype, root, headers, articles, dates and times, navigation and footers. Simple shapes, canvas, Paths, texts, gradients and images. A Form of madness – place holders, autofocus fields, email, and numbers as spin boxes and sliders.

Unit-III-The Basics of JavaScript

15 Hours

Object orientation and JavaScript, Syntax, Primitives, operations and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors, and Pattern matching. The DOM, Elements Access, Event Handling- Body tag, Text Box and Password elements. Element's Positioning, Visibility, Stacking.

Unit-IV- Introduction to Angular-JS and Introduction to XML

15 Hours

ANGULAR JS: Understanding jQuery ,Event Manipulation Methods, AngularJS Template & live data binding, Struts architecture & versions

Introduction to XML

Document structure, DTDs, Namespaces, XML schemas, Displaying XML documents with CSS, Displaying raw XML documents

Recommended Learning Resources:

1. Robert W. Sebesta, Programming the World Wide Web, Pearson Education 2008.
2. Achyut S. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.
3. Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.
4. Paul S Wang, SandaKatila An introduction to Web design and programming Cengage Course, 2003.

Exercises:

Unit 1: Develop a web application using XHTML tags and CSS.

Unit 2: Develop a user registration form using HTML5 Controls and CSS.

Unit 3: Expand the above registration form and add validations using JS.

Unit 4: To the above registration form, read the form data and display it on the next page.

PART-A

1. Create an HTML5 page to demonstrate the usage of
 - a. Text Formatting tags
 - b. Links
 - c. Images
 - d. Tables
2. Develop and demonstrate the usage of inline and external style Sheet using CSS.
3. Write a Program using JavaScript to display a table of the numbers from 5 to 15 and their squares and cubes using alert.
4. Develop and demonstrate using Java script, a XHTML document that display random numbers (integers).
5. Program to demonstrate various event handlers when an image is moved from the top stacking position, it returns to its original position using JavaScript.
6. Develop using Java script, an XHTML document that use of on load and on focus events.
7. Program on xml to read Employee details and display the details using CSS.
8. Develop a web form to display the student details using XML and XSLT style sheets.

PART-B

1. Build a client-side web application in the following areas:
 - a. Educational Institutions.
 - b. Online shopping.
 - c. Hospital Management System.
 - d. Real Estate.
 - e. Reservation System.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS224	System Modelling and Simulation	16	SC	3	1	0	4	5

Course Objective

The objectives of this course are to:

- Learn the benefits of simulation and modeling in a range of important application areas.
- Explain the event – scheduling, time-advance algorithm in computer networks.
- Describe the essentials of probability and random process
- Introduce discrete event stochastic models and **queuing models**

Course Outcomes

On completion of this course the student will be able to:

- Make students to understand the concepts of simulation for systems
- Describe the role of important elements of simulation and modeling paradigm.
- Apply the mathematical techniques to model and analyze structural and dynamical properties of Discrete-Event systems.
- Describe Output analysis for discrete-event simulation algorithms.

Course Contents

Unit-I- Introduction

15 Hours

Why is Simulation Important? When simulation is the appropriate tool and when it is not appropriate, Areas of application, Systems and system environment; Components of a system, Discrete and continuous systems, Model of a system; Types of Models; Discrete-Event System Simulation. Simulation examples: Simulation of queuing systems; Simulation of inventory systems; other examples of simulation. What is model? Advantages and Disadvantages of Modeling and Simulation, Common Pitfalls of Modeling and Simulation and Rules of Thumb, Overview of M&S tools

Simulation Software: Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event scheduling; List processing.

Unit-II-Statistical& Queuing Models

15 Hours

Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions. Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.

Unit-III-Random-Number Generation, Random-Variate Generation**15 Hours**

Properties of random Numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers. Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; selecting input models without data; Multivariate and Time-Series input models.

Unit-IV-Verification and Validation of Simulation Models, Optimization**15 Hours**

Model building, verification and validation; Verification of simulation models; Calibration and validation of models. Optimization via Simulation

Modeling and Simulation using NS2: RF Propagation Wired MANE, Network Layer.

Recommended Learning Resources:

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, "Discrete-Event System Simulation", Pearson Education, 4th edition, 2007.
2. Jack L. Burbank, William Kasch and Jon Ward, "An Introduction to Network Modeling and Simulation for the Practicing Engineer", Wiley publication, 2011.
3. Lawrence M. Leemis and Stephen K. Park, "Discrete – Event Simulation a First Course", Pearson Education/PHI, 4th edition, 2006.
4. Averill M. Law, "Simulation Modeling and Analysis", Tata McGraw-Hill, 4th edition, 2007.
5. ACM Transactions on Modeling and Computer Simulation (TOMACS)
6. IEEE Transactions on Networking (TON)
7. ACM Transactions on Networking (TON)

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs. /Wk.
MS17CS234	Information storage management	16	SC	3	0	1	4	5

Course Objectives:

The objectives of this course are to:

- Identify the components of managing the data center and Understand logical and physical components of a storage infrastructure.
- Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN,CAS
- Understand the business continuity, backup and recovery methods.
- Learn variety of solutions for storing, managing, accessing, protecting, securing, sharing and optimizing information

Course Outcomes

On successful completion of this course, the student will be able to:

- Identify the components of managing the data center and Understand logical and physical components of a storage infrastructure.

- Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN, CAS
- Understand the business continuity, backup and recovery methods.
- Learn variety of solutions for storing, managing, accessing, protecting, securing, sharing and optimizing information

Course Contents

UNIT-I-Introduction to Storage and Management

15 Hours

Introduction to Information Storage Management - Data Center Environment–Database Management System (DBMS) - Host - Connectivity –Storage-Disk Drive Components- Intelligent Storage System -Components of an Intelligent Storage System- Storage Provisioning- Types of Intelligent Storage Systems.

UNIT-II-Storage Networking

15 Hours

Fibre Channel: Overview - SAN and Its Evolution -Components of FC SAN -FC Connectivity-FC Architecture- IPSAN-FCOE-FCIP-Network-Attached Storage- General-Purpose Servers versus NAS Devices - Benefits of NAS- File Systems and Network File Sharing-Components of NAS - NAS I/O Operation -NAS Implementations -NAS File-Sharing Protocols-Object-Based Storage Devices- Content-Addressed Storage -CAS Use Cases.

UNIT-III-Backup and Recovery

15 Hours

Business Continuity -Information Availability -BC Terminology-BC Planning Life Cycle - Failure Analysis -Business Impact Analysis-Backup and Archive - Backup Purpose -Backup Considerations - Backup Granularity - Recovery Considerations -Backup Methods -Backup Architecture - Backup and Restore Operations.

UNIT-IV-Securing and Managing Storage Infrastructure

15 Hours

Information Security Framework -Storage Security Domains-Security Implementations in Storage Networking - Monitoring the Storage Infrastructure -Storage Infrastructure Management Activities - Storage Infrastructure Management Challenges.

Recommended Learning Resources:

1. EMC Corporation, Information Storage and Management, WileyIndia, 2nd Edition, 2011.
2. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, Building Storage Networks, Tata McGraw Hill , Osborne, 2nd Edition, 2001.
4. Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

Information Storage System Lab

1. Write a PL/SQL code to retrieve the employee name, join_date, and designation from employee database of an employee whose number is input by the user.
2. Write a PL/SQL code to show TABLE type of data(Array)
3. Write a PL/SQL code to calculate tax for an employee of an organization – XYZ and to display his/her name & tax, by creating a table under employee database as below.

a. Employee_salary

Emp_no	Basic	HRA	DA	Total_deduction	Net_salary	Gross_salary
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4. Write a PL/SQL code to display employee number, name and basic of 5 highest paid employees.
5. Write a PL/SQL code to calculate the total salary of first n records of emp table. The value of n is passed to cursor as parameter.
6. Write a PL/SQL code to update the salary of employees who earn less than the average salary.

LAB PART B

- i. Create an object type called **current_weather_typ** to model current weather observations. This type should have attributes for city, state, current temperature, and current status (such as snowy, sunny, etc.)
- ii. Create an object table called **current_weather** with the only column defined as the datatype you just created.
- iii. Perform a **DESCRIBE** on both the type and the table you created to verify that all has been created properly
- iv. Insert the following values into the table you created.

City	State	Temp	State
New York	NY	32	Sunny
Boston	MA	27	Cloudy
Chicago	IL	15	Blizard

- v. Query the table to ensure the values have been entered correctly.
- vi. Modify the type to add a new attribute for the wind speed. Query the table to see the results of your change and the values for your new attribute
- vii. Create a procedure called **new_weather** that will insert a new row of data into the table, accepting the type attributes as input.
- viii. Use the new procedure to add a new weather report into the table. Query the table to ensure the data was added correctly.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS215	Big Data and NoSQL	16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Learn the latest trends in databases.
- Acquire knowledge in parallel, distributed databases and its applications.
- Understand the usage of advanced data models.
- Learn emerging databases like Mongo DB, Cassandra, H Base etc.
- Understand the principles behind Map reduce.

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the latest trends in databases
- Distinguish between the types of NOSQL databases.
- Understand the data models in these databases.
- Design and write queries in NOSQL Databases

Course Contents

Unit-I-Introduction to NOSQL

15 Hours

Introduction to NoSQL Definition of NOSQL-Challenges in traditional RDBMS- Need for NOSQL- Big Data and NoSQL, History of NOSQL and Different NOSQL products aggregate data models Need for schema less databases -Types of NOSQL Data bases- key-value Column store, document data models and Graph Data models.

NOSQL Storage Architecture Key-value stores internals -Column Family Databases-internals, Document Databases internals- Graph database internals.

Unit-II-Key-Value Stores and Column stores

15 Hours

Introduction to Key-value stores- Exploring Redis Redis data model Storing Data in and Accessing Data from Apache Redis –Querying in Redis using examples Redis use cases. Introduction to Column stores- Exploring HBASE – HBASE data model Storing Data CRUD operations in HBASE.

Unit-III-Document stores and its applications

15 Hours

Introduction to Document stores, Exploring MongoDB, MongoDB data model, Storing Data in and Accessing Data from MongoDB, Querying in MongoDB using examples, Interact with MongoDB using any one Language Binding(Java/Python/PHP). MongoDB use cases. Mongo DB storage architecture

Unit-IV-Big Data Handling in NoSQL

15 Hours

Big Data processing with MongoDB, Import and Export commands in MongoDB, MongoDB Indexing, Map Reduce concepts, Map Reduce in MongoDB. Horizontal Scaling through sharding.

Advanced NOSQL

Database Administration.

Recommended Learning Resources:

1. The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop Computing, Apress 2010 .
 2. Lars GeorgeHBase: A definitive Guide, OReilly publications,2011.
 3. Josiah L. Carlson, Redis in Action,Manning Publications, 2013.
- Reference Books:
4. “Professional NOSQL” by Shashank Tiwari, 2011, WROX Press
 5. Kristina Chodorow, MongoDB: The Definitive Guide, 2nd Edition, O’Reilly publications,2013
- 6. Joel Grus, Data Science from Scratch, Shrooff publishers, 2017**

Reference Websites:

1. www.mongodb.org
2. www.redis.io
3. www.hbase.apache.org

NoSQL Laboratory

1. NoSQL Lab CRUD operations in Key-value stores Redis
2. CRUD operations using Column family stores HBASE.
3. CRUD- Operations using MongoDB
4. Connecting MongoDB using PHP
5. Import and Export Big Data using MongoDB
6. Indexing in MongoDB
7. Map Reduce Using MongoDB.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS225	Social Network Analytics	16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Analyze the structure and evolution of networks
- Able to gain knowledge from disciplines as diverse as sociology, mathematics, computer science.

Course Outcomes

On successful completion of this course, the student will be able to:

- Analyze the structure and evolution of networks
- Able to gain knowledge from disciplines as diverse as sociology, mathematics, computer science.
- Understand the Online interactive demonstrations and hands-on analysis of real-world data sets.
- Understand the Online interactive demonstrations and hands-on analysis of real-world data sets.

Course Contents

UNIT-I- Introduction to Social Network

15 Hours

Social media mining, Fundamentals, new challenges, key concepts, Good Data vs Bad Data, understanding sentiments, Sentiment Analysis, Classification, supervised social media mining, unsupervised social media mining, human sensors under honest signals.

UNIT-II-Recommendations for Social Networks

15 Hours

Recommendation in Social Media, Challenges, Classical Recommendation Algorithms, Recommendation Using Social Context, Evaluating Recommendations.

UNIT-III- Exploring in Depth

15 Hours

Twitter: Exploring Trending Topics, Discovering What People Are Talking About, Mining Face book: Analyzing Fan Pages, Examining Friendships, Mining LinkedIn: Faceting Job Titles, Clustering Colleagues, Mining Google+: Computing Document Similarity, Extracting Collocations.

UNIT-IV- Mining Web Pages**15 Hours**

web content mining, web structure mining, web usage mining, Natural Language Processing to Understand Human Language, Summarize Blog Posts, Mining Mailboxes, Mining GitHub, Inspecting Software Collaboration Habits, Building Interest Graphs, Mining the Semantically Marked-Up Web: Extracting Micro formats, Inference over RDF.

Recommended Learning Resources:

- Mining the Social Web, 2nd Edition Data Mining Face book, Twitter, LinkedIn, Google+, GitHub, and More By Matthew A. Russell Publisher: O'Reilly Media.
- Social Media Mining with R [Kindle Edition] NATHAN DANNEMAN RICHARD HEIMANN Maksim Tsvetovat & Alexander Kouznetsov, Social Network Analysis for Startups, Sharoo publishers, 2015

Social Network Analytics Lab

The Lab component will be decided by the faculty. The lab can be done either using Python or R.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS235	Internet of Things	16	SC	3	0	1	4	5

Course Objectives

- Understand the basics of “Internet of Things” (IoT).
- Understand the need for IoT
- The elements in IoT.
- RFID as the core technologies enabling IoT.
- Sensor and sensor network as the core technologies enabling IoT.
- The key areas that can apply IoT.

Course Outcomes

- Understand the basics of IoT.
- Understand the technologies that help IoT become reality.
- Understand the programming part in IoT.
- Understand the intricacies involved in an IoT project.

Course Contents**Unit-I-Introduction to Internet of Things****15 Hours**

Definition & Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks , Communication Models , IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing , Big Data Analytics, Communication Protocols , RFID Basics, Embedded Systems, IoT Levels & Deployment Templates.

Unit-II-Domain Specific IoTs

15Hours

Introduction, Home Automation, Smart Lighting, Smart Appliances , Intrusion Detection, Smoke/Gas Detectors, Cities, Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle.

Unit-III-Developing Internet Of Things

15 Hours

IoT Design Methodology, Step 1: Purpose & Requirements Specification, Step 2: Process Specification , Step 3: Domain Model Specification , Step 4: Information Model Specification , Step 5: Service Specifications , Step 6: IoT Level Specification, Step 7: Functional View Specification, Step 8: Operational View Specification ,Step 9: Device & Component Integration, Step 10: Application Development. Case Study on IoT System for Weather Monitoring, Motivation for Using Python

Unit-IV-Advanced topics in IoT

15 Hours

Logical Design of IOT using Python, Introduction to Python, Basics of Programming with Raspberry PI with PYTHON, IOT Physical devices and end points. Python Packages of Interest for IoT-JSON. IoT Physical Servers & Endpoints, Introduction to cloud storage Models for IOT.

Recommended Learning Resources:

1. Internet of Things-An Hands on Approach- Vijay Madiseti (Author), Arshdeep Bahga, 2014.
2. Cuno Pfister Getting Started with the Internet of Things, OReilly, 2011.
3. Francis DaCosta, Rethinking Internet of things, Apress Open Edition, 2013
4. Adrian McEwen, Hakim Cassimally, Design of Internet of Things, 2014 John Wiley and Sons, Ltd.

IoT LAB COMPONENTS

1. Build an ESP8266 IoT Temperature Monitor for a Balcony Garden:
 - Take a temperature reading every 10 minutes.
 - Plot it on thingspeak.com.
 - Put the Arduino to deep sleep using a watchdog timer.
 - Use the *CH_PD* pin of the ESP8266 for disabling the chip when not needed, using a *digitalWrite* on the Arduino.
2. Build a cloud-ready temperature sensor with the Arduino Uno and the IBM Watson IoT Platform:
This project shows the building of a temperature sensor. It uses arduino and IOT platform
3. A Simple IoT Project with the ESP8266 WiFi module: A simple project with ESP8266 wifi module. This project collects the temperature and is displayed on the network.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS216	Pattern Recognition	16	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Study the mathematical morphology necessary for Pattern recognition.
- Introduce the student to various Pattern recognition techniques.
- Study the principles of decision trees and clustering in pattern recognition.

Course Outcomes

On successful completion of this course, the student will be able to:

- Develop and analyze decision tress.
- Design the nearest neighbor classifier.
- Develop algorithms for Pattern Recognition.
- Study the Representation and description and feature extraction.

Course Contents

UNIT-I- Introduction

15 Hours

Introduction: What is Pattern Recognition, Data Sets for Pattern Recognition, Different Paradigms for Pattern Recognition.

Representation: Data Structures for Pattern Representation, Representation of Clusters, Proximity Measures, Size of Patterns, Abstractions of the Data Set, Feature Extraction, Feature Selection, Evaluation of Classifier, Evaluation of Clustering.

UNIT-II - Nearest Neighbor Based Classifier

15 Hours

Nearest Neighbor Based Classifier: Nearest Neighbor Algorithm, Variants of the ANN Algorithm use of the Nearest Neighbor Algorithm for Transaction Databases, Efficient Algorithms, Data Reduction, Prototype Selection.

Bayes Classifier: Bayes Theorem, Minimum Error Rate Classifier, Estimation of Probabilities, Comparison with the NNC, Naïve Bayes Classifier, Bayesian Belief Network.

UNIT-III: Hidden Markov Models

15 Hours

Hidden Markov Models: Markov Models for Classification, Hidden Morkov Models, Classification using HMMs.

Decision Trees: Introduction, Decision Tree for Pattern Classification, Construction of Decision Trees, Splitting at the Nodes, Overfitting and Pruning, Examples of Decision Tree Induction.

UNIT-IV - Support Vector Machines**15 Hours**

Support Vector Machines: Introduction, Learning the Linear Discriminant Functions, Neural Networks, SVM for Classification.

Combination of Classifiers: Introduction, Methods for Constructing Ensembles of Classifiers, Methods for Combining Classifiers.

Recommended Learning Resources:

1. Pattern Recognition: An Algorithmic Approach: Murty, M. Narasimha, Devi, V. Susheela, Spinger Pub, 1st Ed.
2. Machine Learning - Mc Graw Hill, Tom M. Mitchell.
3. Fundamentals Of Speech Recognition: Lawrence Rabiner and Biing- Hwang Juang. Prentice-Hall Pub.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS226	Bio-Informatics	14	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Give introduction to the basic practical techniques of bioinformatics.
- Study the application of bioinformatics and biological databases to problem solving in real research problems.
- Get familiar with a wide variety of internet applications, biological database and will be able to apply these methods to research problems.

Course Outcomes

On successful completion of this course, the student will be able to:

- Describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge.
- Explain the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming
- Predict the secondary and tertiary structures of protein sequences.
- Study the application of bioinformatics and biological databases to problem solving in real research problems.

Course Contents**UNIT-I-Introduction****15Hours**

Definition – Overview- Major databases in Bio Informatics- Molecular biology – Central Dogma- Data retrieval tools – Data mining of Databases – Gene Analysis – Prokaryotic and Eukaryotic Genomes – Sequence Assembly – Gene mapping – Physicalmaps – cloning – ORF – amino acids

– DNA, RNA sequences – Genetic code.

UNIT-II- DNA and Protein Sequences

15 Hours

DNA: working with single DNA sequence : removing vector sequences- verifying restriction maps – PCR design – GC content – counting words – internal repeats – protein coding regions – OR Fing – Genome scan, Protein: predicting properties – primary structure analysis – transmembrane segments – PROSITE patterns – interpreting scanprosite results- finding domains – CD server results – pfscan results.

UNIT-III - Alignment of Pair of Sequences

15 Hours

Terminology – Global and Local alignment Dot matrix – dynamic programming – using scoring matrices –PAM matrices – BLOSUM, Working with FASTA – Algorithm – output – E-values – Histogram, Working with BLAST –algorithm – output – services – gapped BLAST- PSIBLAST – comparison of FASTA and BLAST.

UNIT-IV- Multiple Sequence Alignment

15 Hours

Criteria for Multiple sequence alignment –applications choosing the right sequences; FASTA, ClustalW, Toffee methods –interpreting multiple sequence alignment – getting in right format – converting formats –using Jalview – preparing for publication.

Recommended Learning Resources:

1. S.C Rostogi , Mendiratta, P.Rostogi, “ BioInformatics: methods and applications”,second edition, PHI 2006.
2. Jean Mickel Clavere & Cadrienotredom “Bio Informatics– A beginners guide” Wiley DreamTech.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS236	Natural Language Processing	16	SC	3	0	1	4	5

Course Objectives

The objectives of this course are to:

- Learn basics of Speech technology and parsing
- Introduce the semantic analysis of speech
- Study the machine translation principles

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the Natural language processing research arena.
- Understand and work on various NLP tasks such as, POS tagging, syntactic parsing etc
- Analyze NLP applications such as, Information Retrieval systems and Machine translation system.

- Learn basics of Speech technology and parsing

Course Contents

UIT-I-Introduction

15 Hours

Regular Expressions and Finite State Automata, Morphology and Finite State Transducers

Computational Phonology: Computational Phonology and Text to speech - N-grams: Counting words in Corpora

UNIT-II-HMMS and Speech Recognitio

15 Hours

Speech Recognition Architecture, Overview of HMM, Advanced Methods for decoding, Training a speech Recognizer, Human Speech Recognition, Part of Speech Tagging: Rule Based, Stochastic Part-of-Speech Tagging, Transformation Based Tagging, Context Free Grammars for English, Context Free Rules and Trees, Sentence Level Constructions, Coordination Agreement, Grammars and Human Processing

UNIT-III-Parsing

15 Hours

Parsing with Context Free Grammars, Top down Parser, Problems with Basic Top Down Parser, Finite State Parsing Methods, Representing Meaning: Computational Desiderata for Representations – Meaning Structure of Language, First Order Predicate Calculus

Semantic Analysis: Syntax driven Semantic Analysis – Attached for a Fragment of English- Integrating Semantic Analysis into the Earley Parser, Robust Semantic Analysis

UNIT-IV-Applications of NLP

15 Hours

Applications of NLP- Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.

Machine Translation Overview

Recommended Learning Resources:

1. D. Jurafsky and J. Martin , “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2004
2. C. Manning and H. Schutze , “Foundations of Statistical Natural Language Processing”, Massachusetts Institute of Technology, 2003.
3. James Allen “Natural Language Understanding” ,The Benajmins/Cummings Publishing Company Inc. 1994.
4. Steven Bird,Ewan & Edward Loper,Natural Language Processing with Python,Shroff publisher.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS217	Big Data Security	16	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Understanding significance of privacy, ethics in big data environment
- Analyzing the steps to secure big data
- Building security in Hadoop environment and its ecosystem.
- Analyzing data security and event logging

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand the significance of privacy, ethics in big data environment
- Analyze the steps to secure big data
- Build security in Hadoop environment and its ecosystem.
- Analyze data security and event logging

Course

Contents

UNIT-I: Big Data Privacy, Ethics and Security

15Hours

Privacy – Reidentification of Anonymous People – Why Big Data Privacy is self-regulating? – Ethics
– Ownership – Ethical Guidelines – Big Data Security – Organizational Security.

UNIT-II-Security, Compliance, Auditing, and Protection

15 Hours

Steps to secure big data – Classifying Data – Protecting – Big Data Compliance – Intellectual Property Challenge – Research Questions in Cloud Security – Open Problems.

UNIT-III-Hadoop Ecosystem Security

15 Hours

Kerberos – Default Hadoop Model without security - Hadoop Kerberos Security Implementation & Configuration. Configuring Kerberos for Hadoop ecosystem components – Pig, Hive, Oozie, Flume, HBase, Sqoop

UNIT-IV-Data Security & Event Logging

15 Hours

Integrating Hadoop with Enterprise Security Systems - Securing Sensitive Data in Hadoop – SIEM system – Setting up audit logging in hadoop cluster

Recommended Learning Resources:

1. Mark Van Rijmenam, "Think Bigger: Developing a Successful Big Data Strategy for Your Business", Amazon, 1 edition, 2014.
2. Frank Ohlhorst John Wiley & Sons, "Big Data Analytics: Turning Big Data into Big Money", John Wiley & Sons, 2013.
3. herif Sakr, "Large Scale and Big Data: Processing and Management", CRC Press, 2014.
4. udeesh Narayanan, "Securing Hadoop", Packt Publishing, 2013.
5. Ben Spivey, Joey Echeverria, "Hadoop Security Protecting Your Big Data Problem", O'Reilly Media, 2015.
6. Top Tips for Securing Big Data Environments: e-book
(<http://www.ibmbigdatahub.com/whitepaper/top-tips-securing-big-data-environments-e-book>)
7. <http://www.dataguise.com/?q=securing-hadoop-discovering-and-securing-sensitive-data-hadoop-data-stores>
8. Gazzang for Hadoop <http://www.cloudera.com/content/cloudera/en/solutions/enterprise-solutions/security-for-hadoop.html>
9. eCryptfs for Hadoop <https://launchpad.net/ecryptfs>.
10. Project Rhino - <https://github.com/intel-hadoop/project-rhino/>

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS227	Deep Learning	16	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Understand the basic theory underlying deep learning.
- Formulate deep learning problems corresponding to different applications.
- Introduce deep learning algorithms to solve problems of moderate complexity.

Course Outcomes

On successful completion of this course, the student will be able to:

- Understand what is learning and why it is essential to the design of intelligent machines.
- Design and implement various machine learning algorithms in a wide range of real world applications.
- Acquire knowledge deep learning and be able to implement deep learning models for language, vision, speech, decision making, and more
- Understand a range of deep learning algorithms along with their strengths and weaknesses.

Course Contents

UNIT-I-Complex Systems & Artificial Life

15 Hours

Complex Systems and Artificial Life - Complex Networks - Self-Organization and Emergent Complex Behavior - Cellular Automata - Boolean Networks -Development and Morphogenesis - Open-ended evolution.

UNIT-II-Natural Computation and Neural Networks

15 Hours

Biological Neural Networks- Artificial Neural Nets and Learning – pattern classification & linear separability - single and multilayer perceptrons, backpropagation - associative memory - Hebbian learning - Hopfield networks - Stochastic Networks – Unsupervised learning

UNIT-III-Evolutionary Systems and Algorithms

15 Hours

Evolutionary Programming: biological adaptation & evolution – Autonomous Agents and Self-Organization: termites, ants, nest building, flocks, herds, and schools. Genetic algorithms: Schema theorem.

UNIT-IV-Competition, Cooperation and Swarm Intelligence

15 Hours

Collective Behavior and Swarm Intelligence - Social Insects - Stigmergy and Swarm Intelligence; Competition and Cooperation - zero- and nonzero-sum games - iterated prisoner's dilemma - stable strategies - ecological & spatial models - Communication and Multi-Agent simulation – Immuno-computing.

Recommended Learning Resources:

1. Leandro Nunes De Castro, Fernando Jose Von Zuben, "Recent Developments in Biologically Inspired Computing", Idea Group Publishing, 2005.
2. Leandro Nunes De Castro , "Fundamentals of Natural Computing: Basic concepts, Algorithms and Applications", Chapman & Hall/ CRC Computer & Information Science Series, 2006.
3. Dario Floreano, Claudio Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", MIT Press, 2008.
4. Nikhil Buduma with contributions by Nicholas Locascio, Fundamentals of Deep Learning, Shroff Publishers,2017.

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS237	Data warehousing and Business Intelligence	16	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Be exposed with the basic rudiments of business intelligence system
- understand the modeling aspects behind Business Intelligence
- understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

Course Outcomes

On successful completion of this course, the student will be able to:

- Explain the fundamentals of business intelligence.
- Link data mining with business intelligence.
- Apply various modeling techniques.
- Decide on appropriate technique.

Course Contents

Unit-I-Technical-Architecture

15 Hours

Technical architecture introduction , Back room architecture , Presentation server architecture , Front room architecture – Infrastructure – Metadata , Security

Dimensional Modeling

Making the case for dimensional modeling, Dimensional modeling primer, Enterprise data warehouse bus architecture – Updates to the dimension tables , Miscellaneous dimensions , The snowflake schema

Unit-II-Designing the Dimensional Modeling**15 Hours**

Modeling process overview , Getting organized , Four step modeling process , Design the dimensional model -Embrace data stewardship , Extract, Transform and Load overview , Extract, Transform and Load requirements and steps , Data extraction , Data transformation , Data loading.

Unit-III-Business Intelligence Applications**15 Hours**

Importance of business intelligence applications , Analytical cycle for business intelligence , Types of business intelligence applications , Navigating applications via the business intelligence portal.

Unit-IV-Designing and Developing Business Intelligence Applications**15 Hours**

Business intelligence application resource planning , Business intelligence application specification , Business intelligence application development , Business intelligence application maintenance.

Measures, Metrics, KPIs, and Performance Management

Understanding Measures and Performance; Measurement System Terminology; Navigating a Business Enterprise, Role of Metrics, and Metrics Supply Chain; “Fact-based Decision Making” and KPIs; KPI Usage in Companies; Where Do Business Metrics and KPIs Come From? Connecting the Dots: Measures to Business Decisions and Beyond

Recommended Learning Resources:

1. Raiph Kimball-Ross, The Data Warehouse Lifecycle Toolkit, Wiley Publication, 2008.
2. Ponniah, Data Warehousing Fundamental, Wiley Publication, 2010.

THIRD SEMESTER

Sl. No	Code	Title	HC/SC/OE	Credit Pattern			Credits	Working Hours
				L	T	P		
1.	MS17CS301	Open Elective	OE	3	1	0	4	5
2.	MS17CS312	Mobile n/w and computing	SC	3	1	0	4	5
	MS17CS322	Object Oriented Software Engineering						
	MS17CS332	IT Security						
3.	MS17CS313	Multivariate Methods for Data Analysis	SC	3	1	0	4	5
	MS17CS323	Stochastic Decision Science						
	MS17CS333	Advanced Web Technologies						
4.	MS17CS304	Minor Project / Internship	HC	1	1	6	8	15
Total Credits				10	3	6	2	25

Course Code	Mobile N/W and computing	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS312		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Explain the major concepts and techniques in the field of mobile computing.
- Describe the 2G and 3G communication systems
- Describe Mobile IP and Mobile TCP.
- Describe basic concepts of Pervasive Computing.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Understand Bluetooth, 2G, 3G, Wi-Fi, WiMAX, Mobile IP, IrDA and ZigBee protocols.
- Realize mobile device data security, mobile ad-hoc and wireless sensor networks.
- Understand Handoff in wireless mobile networks and basic concepts of Pervasive Computing.
- Explain the Security in mobile computing, Handoff in wireless mobile networks

Course Contents:

Unit-I-Mobile Computing Environment

15 Hours

Functions-architecture-design considerations, content architecture –CC/PP exchange protocol, context manager. Data management in WAE-Coda file system-caching schemes-Mobility QOS, Security in mobile computing.

Unit-II-Handoff in wireless mobile networks

15 Hours

Reference model handoff schemes. Location management in cellular networks-Mobility models-location and tracking management schemes-time, movement, profile and distance based update strategies.ALI technologies.

Unit-III - Wireless transmission

15 Hours

Frequencies for radio transmission, Signals, Signal propagation, Multiplexing, Modulation, Cellular systems

Telecommunications systems GSM, CDMA,LTE,(2G,3G,4G),DECT, TETRA, UMTS and IMT-2000,Bluetooth.

Broadcast systems: Overview, Cyclical repetition of data, Digital audio broadcasting,Multi-media object transfer protocol, Digital video broadcasting, Convergence of broadcasting and mobile communications

Unit-IV

15 Hours

Basic Security Concepts; GSM and UMTS Security and Attacks; Vulnerabilities in Cellular Services. Cellular Jamming Attacks and Mitigation Security in Cellular VoIP Services.

Recommended Learning Resources:

1. Ivan Stojmenovic, Handbook of Wireless Networks and Mobile Computing, John Wiley & Sons Inc., Canada, 2002, Mobile Communications J. Schiller, Pearson education publishing 2003
2. Asoke K Taukder, Roopa R Yavagal, Mobile Computing, Tata McGraw Hill, New Delhi, 2005.
3. SengLoke, Context-Aware Computing Pervasive Systems, Auerbach Pub., New York, 2007.
4. Uwe Hansmann et al., Pervasive Computing, Springer, New York, 2001.
5. F. Adelstein, K.S. Gupta, Golden G. Richard, and Loren Schwiebert, Fundamentals of Mobile and Pervasive Computing, McGraw-Hill, 2005.
6. Nouredine Boudriga, Security of Mobile Communications, CRC Press, 2010.
7. L. Buttyán and J. Hubaux, Security and Cooperation in Wireless Networks, Available online at secowinet.epfl.ch/fulltext/SeCoWiNetV1.5.1.pdf

Course Code	Object Oriented Software Engineering	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS322		14	SC	3	1	0	4	5

Course Objectives

The objectives of this course are to:

- Apply software engineering theory, principles, tools and processes, as well as the theory and principles of computer science and mathematics, to the development and maintenance of complex, scalable software systems.
- Design and experiment with software prototypes
- Select and use software metrics
- Communicate effectively through oral and written reports, and software documentation

Course Outcomes

On successful completion of this course, the student will be able to:

- Apply knowledge of mathematics, science, and engineering.
- Design and conduct experiments, as well as to Analyze and interpret data.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, safety, and sustainability.
- Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings

UNIT I - Introduction**15 Hours**

System Development as industrial process – System life cycle – Object Orientations – Object Oriented System Development – Object Oriented Programming.

UNIT II- Model Architecture**15 Hours**

Architecture – Model building – Model architecture – requirements model – analysis model – Design Model – Implementation Model – Test Model.

UNIT III – Model Analysis**15 Hours**

Analysis – Requirements Model – Analysis Model. Construction – Design Model – Block Design – Working with construction.

UNIT IV- Model Classification**15 Hours**

Real Time Specialization – Classification – Analysis – Construction – Testing – Verification – Data specialization – ODBMS – Components Definition – Use – Management – Testing unit testing – integration testing – system testing – process.

Recommended Learning Resources:

1. Ivar Jacobson, “Object –Oriented Software Engineering”, Pearson Education, Delhi, 2002.
2. Roger S. Pressman, “Software Engineering”, Fifth Edition, McGraw-Hill Internal Edition, Singapore, 2001.

Course Code	IT Security	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS332		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Understand essential concepts for cyber & IT security,
- Get Knowledge of cyber security applications, cyber crimes, unauthorized crimes and hacking.
- Study prohibited action on cyber policies, evaluation of crime scene, evidence collection, cyber security law and policies.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Understand cyber security applications and principles.
- Analyse about cyber-crimes and Email frauds.
- Understand prohibited action on IPR violations, prevention of forgery and card related crimes.
- Understanding the forensic tool and evidence collection.

Course Contents:**UNIT-I - Introduction to information systems****15 Hours**

Introduction to information systems, Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

UNIT-II - Application security**15 Hours**

Application security (Database, E-mail and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Intrusion Detection, AccessControl. Security Threats -Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack, Security Threats to E-CommerceElectronic Payment System, e• Cash, Credit/Debit Cards. Digital Signature, public Key Cryptography.

UNIT-III - Developing Secure Information Systems**15 Hours**

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design Security Issues in Hardware, Data Storage & Downloadable Devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

UNIT-IV - Security Policies**15 Hours**

Security Policies, Why Policies should be developed, WWW policies, Email Security policies, Policy Review Process-Corporate policies-Sample Security Policies, Publishing and Notification Requirement of the Policies. Information Security Standards-ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India; IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Patent Law.

Recommended Learning Resources:

1. Charles P. Pfleeger, Shari Lawerance Pfleeger, "Analysing Computer Security ", Pearson Education India.
2. V.K. Pachghare, "Cryptography and information Security", PHI Learning Private Limited, Delhi India.
3. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla , "Introduction to Information Security and Cyber Law" Willey Dreamtech Press.
4. Schou, Shoemaker, " Information Assurance for the Enterprise", Tata McGraw Hill.

Course Code	Multivariate Methods for Data Analysis	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
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MS17CS313		14	SC	3	1	0	4	5
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Course Objectives:

The objectives of this course are to:

- Introduce the students into the field of Multivariate Techniques for analyzing large volumes of data and to take decisions based on inference drawn.
- Data characteristics and form of Distribution of the Data Structures
- Understanding the usage of multivariate techniques for the problem under the consideration
- Draw valid inferences and to plan for future investigations.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Apply the concepts in the field of Multivariate Techniques for analyzing large volumes of data and to take decisions based on inference drawn.
- Analyse Data characteristics and form of Distribution of the Data Structures
- Apply the usage of multivariate techniques for the problem under the consideration
- Draw valid inferences and to plan for future investigations.

Course Contents:

UNIT I - Introduction to Multivariate Analysis

15 Hours

Meaning of Multivariate Analysis, Measurements Scales - Metric measurement scales and Non-metric measurement scales, Classification of multivariate techniques (Dependence Techniques and Inter-dependence Techniques), Applications of Multivariate Techniques in different disciplines.

UNIT II – Factor Analysis

12 Hours

Factor Analysis: Meanings, Objectives and Assumptions, Designing a factor analysis, Deriving factors and assessing overall factors, Interpreting the factors and validation of factor analysis.

UNIT III – Cluster Analysis

13 Hours

Cluster Analysis: Objectives and Assumptions, Research design in cluster analysis, Deriving clusters and assessing overall fit (Hierarchical methods, Non Hierarchical Methods and Combinations), Interpretation of clusters and validation of profiling of the clusters.

UNIT IV - Discriminant Analysis & Linear Programming

20Hours

Discriminant Analysis- concept, objective and applications. Procedure for conducting discriminant analysis. Stepwise discriminate analysis and Mahalanobis procedure. Logit model.

Linear Programming : Linear Programming problem - Formulation, graphical method, simplex method. Integer Programming. Transportation and Assignment problem.

Recommended Learning Resources:

1. Joseph F Hair, William C Black et al , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
2. T. W. Anderson , “An Introduction to Multivariate Statistical Analysis, 3rd Edition”, Wiley, 2003.
3. William r Dillon, John Wiley & sons, “Multivariate Analysis methods and applications”, Wiley, 1984.
4. Naresh K Malhotra, Satyabhusan Dash, “Marketing Research An applied Orientation”, Pearson, 2011.
5. Hamdy A Taha, “Operations Research”, Pearson, 2012.
6. S R Yadav, A K Malik, “Operations Research”, Oxford, 2014.

Course Code	Stochastic Decision Science	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS323		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering.
- Introduce students to the basic methodology of “probabilistic thinking” and to apply it to problems;
- Understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
- Analysis of random process and application to the signal processing in the communication system.

Course Outcomes:

On successful completion of this course; the student will be able to:

- Compute simple probabilities using an appropriate sample space.
- Apply simple probabilities and expectations from probability density functions (pdfs)
- Analyse Least -square & maximum likelihood estimators for engineering problems.
- Project Mean and covariance functions for simple random processes.

Course Contents:

Unit I: Random Variables and their Probability Distributions 15 Hours

Random Variables: Probability distribution function - probability density function - conditional probability - statistical independence - Bayes formula; Moments of random variables: Expected value and moments - mean and variance of random variable – coefficients of variation - skewness and kurtosis - moments - covariance and correlation coefficient - mean and variance of sum and product of two random variables - conditional mean and variance - application of conditional mean and variance.

Moment Generation Function: Characteristics function - cumulants - probability generating function - binomial distribution - negative binomial distribution - hypergeometric distribution - multinomial - Poisson distributions - relationship between various discrete type distributions.

Unit III: Transformation of Random Variables

15 Hours

Transformation of Single and Several Random Variables: Function of random variables – sum - differences - product and ratio of two random variables - transformation through characteristic functions.

Unit IV: Stochastic Processes

15 Hours

Introduction: Classification of stochastic process - stationary process (SSS and WSS) - ergodic process - independent increment process - Markov process - counting process - narrowband process - normal process - Wiener Levy process - Poisson - Bernoulli – shot noise process - autocorrelation function.

Recommended Learning Resources:

1. Michel K. Ochi, “Applied Probability and Stochastic Processes”, John Wiley and Sons, 2008.
2. Paboulis A., “Probability, Random Variables and Stochastic Processes”, Tata McGraw Hill, 1984.
3. Kishor S. Trivedi, “Probability and Statistics with Reliability Queuing and Computer Science Application”, John Wiley and Sons, 2002.

Course Code	Advanced Web Technologies	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS333		14	SC	3	1	0	4	5

Course Objectives:

The objectives of this course are to:

- Learn the concepts of server programming by using PHP
- Understand the use of Java servlets

Course Outcomes:

On successful completion of this course; the student will be able to:

- Design a server side webpage by using PHP
- Use Java servlets
- Use the concepts of RDF
- Understand the RDF and Semantic Web

Course Contents:

UNIT I - Introduction to PHP

15 Hours

Introduction to PHP, Language Features. PHP Basics, PHP’s Supported Data Types, Identifiers, Variables, Constants, Expressions, String Interpolation, Control Structures, Functions, Arrays, Strings and Regular Expressions, Working with the File and Operating System.

UNIT II - Introduction to Java Servlets

15 Hours

Introduction to Java Servlets, Static and Dynamic contents, Servlet life Cycle and Life cycle methods, Servlet Request and Response Model, Deploying a Servlet, Servlet State Transitions, Servlet Config and Servlet Context, Servlet Redirection and Request Dispatch, Servlet Synchronization and Thread Model. Maintaining Client State: Cookies, URL rewriting, Hidden form fields, Session Tracking.

UNIT – III - Introduction to Semantic Web

15 Hours

Introduction to Semantic Web: Web, Web 2.0, Syntactic Web, Web 3.0 and Semantic Web; why Semantic Web; Impact of Semantic Web; Myths about Semantic Web; Semantic Modeling. Overview of Web and XML technologies

UNIT – IV - NodeJS

15 Hours

NodeJS: Basics, Node.js Global, Node.js Process, Modules and Require in Node.js, Core Node.js Modules, Node.js Module Patterns, Node.js Command-Line Interface Arguments, Running Node.js Scripts, Node.js Shell (REPL), Node.js File System Module.

Recommended Learning Resources:

1. Holzner, Steven. *PHP: the complete reference*. Tata McGraw-Hill Education, 2007.
2. Hall, Marty, Larry Brown, and Yaakov Chaikin. *Core Servlets and JavaServer Pages, Volume 2: Advanced Technologies*. Pearson Education, 2007.
3. Nandini, Dhana. "Semantic Web And Ontology-eBooks and textbooks from bookboon.com." (2014).
4. Cantelon, M., Harter, M., Holowaychuk, T. J., & Rajlich, N. (2014). Node. js in Action (pp. 17-20). Manning.

Fourth Semester

Course Code	Course Title	Duration (Weeks)	Course Type	L	T	P	C	Hrs./Wk.
MS17CS304	Minor Project / Internship	14	HC	1	1	6	8	15

Guide Lines

Project survey has to be completed and problem identification for the project must be done. Students must meet the guide and discuss with due PPT presentations at least two hours per Wk. and do the necessary ground work for Phase II devoting at least 6 hours per Wk..

- The project should be inter disciplinary
- Team size should be of max *one* members
- Use any version control software
- Project should be of Research Based
- Proper and meaningful reports should be generated by making use of latest reporting tools
- Project report should follow standard template with the following contents:
 - a) Abstract
 - b) Introduction to project
 - c) Literature Review
 - d) Basic Diagrams like (DFD, ER, Class diagram, etc..)
 - e) Methodology
 - f) Result Analysis
 - g) Concussion
 - h) Future enhancement
 - i) Bibliography
- project reports should be submitted for evaluation

much more than just a degree. They want graduates who stand out from the crowd and exhibit real life skills that can be applied to their organizations. Examples of such popular skills employers look for include:

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

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counseling and Placement division, namely Career Development Center (CDC) headed by well experienced senior Professor and Dean and supported by dynamic trainers, counselors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality. The need of the hour in the field of Commerce is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career.

The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students

and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The various skill/certification programs identified are as follows:

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

The University has signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

LIST OF FACULTY MEMBERS



Dr. S. Senthil, Associate Professor and Director has completed his B.Sc (Applied Sciences – Computer Technology) from P.S.G College of Technology, MCA from Bharathidasan University, M.Phil in Computer Science from Manonmaniam Sundaranar University and Ph.D in Computer Science from Bharathiar University. He has passed State Eligibility Test conducted by Bharathiar University. While he has an experience of 18 years in teaching, his areas of interest are RDBMS, Data Mining, Data Compression, Computer Networks and Data Structures. He has published 30 papers in various National and International Journals of repute. He has presented a paper entitled "Lossless Preprocessing Algorithms for better Compression" in an IEEE International Conference at Zhangjiajie, China. He was also the recipient of the best paper awards, at an International Conference on “Wisdom Based Computing” at Thiruvananthapuram and at a National Conference on “Transforming India through Digital Innovations” at Guru Shree Shantivijai Jain College for Women, Chennai. (Email Id-dir.csa@reva.edu.in)



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