REVA UNIVERSITY

Bengaluru, India

# SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

## M. TECH – COMPUTER SCIENCE AND ENGINEERING HANDBOOK [PART TIME]

2018-21

Rukmini Educational Charitable Trust

REVA UNIVERSITY
Bengaluru, India

# SCHOOL OF COMPUTING & INFORMATION TECHNOLOGY

**(Part -time)**

## HANDBOOK

**M. Tech. in Computer Science and Engineering**

**2018-2021**

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Rukmini Educational
Charitable Trust

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# Chancellor's Message

"Education is the most powerful weapon which you can use tochange the world."
- Nelson Mandela.
There was a time when survival depended on just the realization of physiological needs. We are indeed privileged to exist in a time when 'intellectual gratification' has become indispensable. Information is easily attainable for the soul thatis 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 ourportals. Driven by our founding philosophy of 'Knowledge is power', we believe in building a community of perpetual learners by enabling them to look beyond their abilities and achieve what they assumed impossible.

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

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

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

**Dr. P. Shyama Raju**
**The Founder and Hon'ble Chancellor, REVA University**

# Vice-Chancellor's Message

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

A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of Reva University.At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft- skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.With firm faith in the saying, "Intelligence plus character –that is the goal of education" (Martin Luther King, Jr.), I strongly believe REVA University is marching ahead in the right direction, providing a holistic education to the future generation and playing a positive role in nation building. We reiterate our endeavor to provide premium quality education accessible to all and an environment for the growth of over-all personality development leading to generating "GLOBAL PROFESSIONALS". Welcome to the portals of REVA University

**Dr.S Y Kulkarni**
**Vice-Chancellor,**
**REVA University**

# Director's –Message

I congratulate and welcome all the students to the esteemed school of Computing and Information technology (IT). You are in the right campus to become a computer technocrat. The rising needs of automation in Industry

4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of computers and IT. The B.Tech and M.Tech program curriculum and Ph.D areas in the school are designed to cater to the requirements of industry and society.

The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, AMD, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc).

This handbook presents the M.Tech in Computer Science and Engineering program curriculum. The program is of 2 years duration and split into 4 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of CSE. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, AI, Data Science, and Systems. Theoretical foundations of engineering, science, and computer science are taught in first two Semesters. Later, advanced courses and recent technologies are introduced insubsequent semesters for pursuing specialization.

The important features of the M.Tech CSE are as follows: 1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, Genetic Engineering, NLP, Swarm Intelligence, IOT and Cybersecurity,

3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft skills training and 10) Platform for exhibiting skills in cultural, sports and technical activities through clubs and societies.

The curriculum caters to and has relevance to local, national, regional, and local developmental needs. Maximum number of courses are interpreted with cross cutting issues relevant to professional ethics generic human values environmental and sustainability.

The school has well qualified faculty members in the various areas of computing and IT including cloud computing, security, IOT, AI, ML and DL, software engineering, computer networks, cognitive computing, etc. State of art laboratories are available for the purpose of academics and research.

Dr. Sunilkumar S Manvi

Director, School of C&IT, REVA University

## CONTENTS


| Sl. No. | Particulars | Page **No**. |
|---|---|---|
| 1 | Message from the Hon'ble Chancellor | 2 |
| 2 | Message from the Vice- Chancellor | 3 |
| 3 | Message from Director | 4 |
| 4 | Rukmini Educational Charitable Trust | 6 |
| 5 | About REVA University<br>Vision, Mission, Objectives | 7 |
| 6 | About School of Computing and Information Technology<br>Vision<br>Mission<br>Advisory Board<br>BoS | 10 |
| 7 | Programme Overview<br>Programme Educational Objectives<br>Programme Outcomes<br>Programme Specific Outomes | 12 |
| 9 | Regulations Governing M.Tech. programmes | 16 |
| 10 | Curriculum- M. Tech (Computer Science and Engineering) | 26 |

## RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified, experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 13,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conducive environment for the knowledge driven community.

## ABOUT REVA UNIVERSITY

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

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

REVA consistently ranked as one of the top universities in various categories because of the diverse community of international students and its teaching excellence in both theoretical and technical education in the fields of Engineering, Management, Law, Science, Commerce, Arts, Performing Arts, and Research Studies. REVA offers 28 Undergraduate Programmes, 22 Full-time and 2 Part-time Postgraduate Programmes, 18 Ph. D Programmes, and other Certificate/ Diploma/Postgraduate Diploma Programmes in various disciplines.

The curriculum of each programme is designed with a keen eye for detail by giving emphasis on hands-on training, industry relevance, social significance, and practical applications. The University offers world-class facilities and education that meets global standards.

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

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering

science & technology and other areas of study.

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

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

The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, 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.

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

## Vision

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

## Misson

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

## Objectives

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

## About the School of Computing and Information Technology (C & IT)

The School has a rich blend of experienced and committed faculty who are well-qualified in various aspects of computing and information technology apart from the numerous state-of-the art digital classrooms and laboratories having modern computing equipment. The School offers one undergraduate program: B Tech in Computer Science and Engineering and Three postgraduate programs offered in the school are: M Tech in Data Engineering and Cloud Computing and M Tech in Computer Science and Engineering (Both Full Time & Part Time). In addition, the school has a unique academic collaboration with the University of Alabama in Huntsville to jointly offer an MS program in Computer Science. In addition, the school has a research center in which students can conduct cutting edge research leading to a PhD degree.

Curricula of both undergraduate and postgraduate programs have been designed through a collaboration of academic and industry experts in order to bridge the growing gap between industry and academia. This makes the program highly practical-oriented, and thus industry resilient. The B Tech program aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world. The masters' degrees focus on quality research and design in the core and application areas of computing to foster a sustainable world and to enhance the global quality of life by adopting enhanced design techniques and applications. This thought is reflected in the various courses offered in the masters' programs.

### Vision

To create a pool of high-caliber technologists and researchers in computer science and information technology who have potential to contribute to the development of the nation and the society with their expertise, skills, innovative problem-solving abilities, and strong ethical values.

### Mission

- Create a center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders, and innovators.
- Provide quality education in both theoretical and applied foundations of computer science information technology and related inter-disciplinary areas and to train students to effectively apply the education to solve real-world problems.
- Amplify students potential for life-long high-quality careers and give them a competitive advantage in the ever-changing and challenging global work environment of the 21st century.
- Forge research and academic collaboration with industries and top global universities in order to provide students with greater opportunities.
- Support the society by encouraging and participating in technology transfer Quality Policy.

## Advisory Board

| Serial Number | Name and Designation of the Members |
|---|---|
| 1 | Mr. Himesh Misra,Program Director,<br>IBM Innovation Center, IBM India Private Limited<br>Bengaluru-560017 |
| 2 | Dr. Rajkumar Buyya,Director,<br>Cloud Computing and Distributed Systems Laboratory<br>Department of Computing and Information Systems<br>University of Melbourne, Australia |
| 3 | Mr. Chethan Shivkumar, Founding Director,<br>AIKAAN Labs, Bengaluru |
| 4 | Mr. P. B. Kotur, Global Goodwill Ambassador<br>Wipro Limited<br>Bengaluru, India |
| 5 | Dr. Sajal Das, Professor,<br>Department of CS&E<br>Missouri University of Science and Technology, USA |
| 6 | Dr. Heggere S Ranganath, Professor and Chair,<br>Computer Science Department<br>University of Alabama in Huntsville<br>Huntsville, AL 35899, USA |
| 7 | Mr. Mrityunjay Hiremath, Director,<br>AMD Inc. USA, Bengaluru |
| 8 | Dr. Shirshu Verma, Professor and Registrar,<br>IIIT Allahabad<br>Allahabad, India |
| 9 | Dr. K. Gopinath, Professor,<br>Dept. of Computer Science and Automation<br>IISc., Bengaluru |
| 10 | Dr. S. S. Iyengar,Professor,<br>Louisiana State University (LSU),<br>USA. |

**MEMBERS OF BOARD OF STUDIES**

| Sl. No | Name and Affiliation | Role |
|---|---|---|
| 1 | Dr Sunil Kumar S Manvi, Professor and Director<br>School of C & IT, REVA University | Chairman |
| 2 | Dr Mallikarjuna Shastry P M, Professor<br>School of C & IT, REVA University | Member |
| 3 | Dr Kiran Kumari Patil, Director UIIC<br>REVA University | Member |
| 4 | Dr Mallikarjuna M Kodabagi, Professor and Deputy Director<br>IQAC, REVA University | Member |
| 5 | Dr Ashwin Kumar U M, Associate Professor,<br>School of C & IT, REVA University | Member |
| 6 | Dr Gopala Krishna Shyam, Associate Professor,<br>School of C & IT, REVA University | Member |
| 7 | Mr. Chetan Shivakumar, CEO & Cofounder,<br>Aikaan Labs Pvt Ltd, Bengaluru. | Member |
| 8 | Mr. Muralidhar Jahagirdhar, Practice Head Engineering,<br>ATMECS Technology Pvt Ltd, Hyderabad | Member |
| 9 | Mr. Ravikant Soni, Technical Manager, Solution Architect,<br>Standard Chartered bank, Bengaluru. | Member |
| 10 | Dr Sanjay, HoD Dept. of ISE,<br>NITTE Meenakshi Institute of Technology, Bengaluru | Member |
| 11 | Dr Raghavendra Kulkarni, Director of Academics,<br>M. S. Ramaiah University of Applied Sciences, Bengaluru | Member |

# Program Overview

## M Tech (Computer Science & Engineering) Program

Computer Science Engineering (CSE) encompasses a variety of topics that relates to computation, like development of algorithms, analysis of algorithms, programming languages, software design and computer hardware. Computer Science engineering has roots in electrical engineering, mathematics, and linguistics. In the past Computer Science was taught as part of mathematics or engineering departments and in the last 3 decades it has emerged as a separate engineering field. In the present information era (Knowledge era) computer science and engineering will see an exponential growth as the future machines work on artificial intelligence.

The oldest known complex computing device, called the Antikythera mechanism, dates back to 87 B.C., to calculate astronomical positions and help Greeks navigate through the seas. Computing took another leap in 1843, when English mathematician Ada Lovelace wrote the first computer algorithm, in collaboration with Charles Babbage, who devised a theory of the first programmable computer. But the modern computing- machine era began with Alan Turing's conception of the Turing Machine, and three Bell Labs scientists invention of the transistor, which made modern- style computing possible, and landed them the 1956 Nobel Prize in Physics. For decades, computing technology was exclusive to the government and the military; later, academic institutions came online, and Steve Wozniak built the circuit board for Apple-1, making home computing practicable. On the connectivity side, Tim Berners-Lee created the World Wide Web, and Marc Andreessen built a browser, and that's how we came to live in a world where our glasses can tell us what we're looking at. With

wearable computers, embeddable chips, smart appliances, and other advances in progress and on the horizon, the journey towards building smarter, faster and more capable computers is clearly just beginning.

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 computer science and engineering graduates are plenty and growing. Programming and software development, information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the opportunitiesthe graduates find.

The School of Computing and Information Science at REVA UNIVERSITY offers M.Tech., Computer Science and Engineering programme to create motivated, innovative, creative thinking graduates to fill ICT positions across sectors who can conceptualize, design, analyse, and develop ICT applications to meet the modern day requirements.

The M.Tech., in Computer Science and Engineering curriculum developed by the faculty at the School of Computing and Information Science, is outcome based and it comprises required theoretical concepts and practical skills in the domain. By undergoing this programme, students develop critical, innovative, creative thinking and problem solving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with ICT sector makes this programme unique.

## Program Educational Objectives (PEO's)

After few years of graduation, the graduates of M. Tech. (Computer Science and Engineering) will:

**PEO-1:** Have successful professional careers in industry, government, academia and military as innovative engineers.

**PEO-2:** Successfully solve engineering problems associated with the lifecycle of Computer Science and Engineering either leading a team or as a team member.

**PEO-3:** Continue to learn and advance their careers through activities such as research and development, acquiring doctoral degree, participation in national level research programme, teaching and research at university level etc.

**PEO-4:** Be active members ready to serve the society locally and internationally, may take up entrepreneurship for the growth of economy, to generate employment and adopt the philosophy of lifelong learning to be aligned with economic and technological development.

## Program Outcomes (POs)

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

**PO1.** Demonstrate in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

**PO2.** Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

**PO3.** Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

**PO4.** Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

**PO5.** Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

**PO6.** Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

**PO7.** Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

**PO8.** Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations and give and receive clear instructions.

**PO9:** Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

**PO10.** Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

**PO11.** Observe and examine critically the outcomes of one's actions and make corrective measures

subsequently, and learn from mistakes without depending on external feedback (SELF learning)

## Programme Specific Outcomes (PSO's)

On successful completion of the program, the graduates of M Tech. (Computer Science and Engineering) program will be able to:

**PSO-1:** Isolate and solve complex problems in the domains of Computer Science and Engineering using latest hardware and software tools and technologies, along with analytical and managerial skills to arrive at cost effective and optimum solutions either independently or as a team.

**PSO-2:** Implant the capacity to apply the concepts of wireless communications, advanced computer networks, network security, IoT and cyber physical systems, etc. in the design, development and implementation of application-oriented engineering systems.

**PSO-3:** Review scholarly work by referring journals, define a new problem, design, model, analyze and evaluate the solution and report as a dissertation in the area of Data Science.

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

**1.0 Teaching and Learning Process**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**(v) O**pen Elective Course:**

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

**2.2. Project Work:**

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

**2.3. Minor Project:**

A project work up to **Six to Eight credits** is called **Minor Project** work.A Minor Project work may be a hard core or a Sof 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 Majo Project / Dissertation shall be Hard Core.

**3.0. Minimum Credits to be earned:**

**3.1.** A candidate has to earn 96 credits for successful completion of M Tech degree with a distribution of credits for differen courses as prescribed by the university.

**3.2.** A candidate can enroll for a maximum of 26 credits per Semester. However he / she may notsuccessfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by 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 fo 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. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M .Tech degree.

**4.1. Add on Proficiency Diploma:**

In excess to the minimum of 96 credits for the M. Tech degree program, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline/subject or in different discipline / subject to acquire Add on Proficiency Diploma in that particular discipline / subject along with the B. Tech degree. The A**dd -on Proficiency Certification / Diploma** s issued to the candidate contains the courses studied and grades earned.

**5.0. Continuous Assessment, Earning of Credits and Award of Grades.**

**5.1.** The assessment and evaluation process happen in a continuous mode. However, for reporting purpose, **a semester i divided into 3 Components as C1, C2, and C3.**The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

**(i) Component C1:**

**The first Component (C1), of assessment is for 25 marks.** This will be based on test, assignment / seminar During the first half of the semester (i.e. by 8th Wk.), the first 50% of the syllabus (Unit 1&2) will be completed This shall be consolidated during the first three days of 8th Wk. of the semester. A review test based on C1 will be conducted and completed in the beginning of the 9th Wk.. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th Wk.. The academic sessions will continue for C2 immediately after completion of proces of C1.

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

Assignment.....05 marks for Unit 1&2
Seminar.....05 marks for Unit 1&2
Test (Mid-Term).....15 marks for Unit 1&2
Total .....25 marks

**(ii) Component C2:**

**The second component (C2), of assessment is for 25 marks.** This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th Wk.) will be consolidated during 16th Wk. of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on C2 will be conducted and completed during 16th Wk. of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th Wk..
The 17th Wk. will be for revision of syllabus and preparation for the semester - end examination.

The finer split - up for the award of marks in C2 is as follows:
Assignment.....05 marks for Unit 3 & 4
Seminar.....05 marks for Unit 3 & 4
Review Test (Mid-Term).....15 marks for Unit 3 & 4
Total .....25 marks

**(iii) Component C3:**

The end semester examination of 3 hours duration for each course shall be conducted during the 18th & 19th Wk. **This forms the third / final component of assessment (C3) and the maximum marks for the final component will be 50.**

## 5.2. Setting Questions Papers and Evaluation of Answer Scripts:

5.2.1. There shall be three sets of questions papers set for each course. Two sets of question papers shall be set by the internal and one set by external examiner for a course. The Chairperson of the BoE shall get the question papers set by internal and external examiners.

5.2.2. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation.

5.2.3. There shall be single valuation for all theory papers by internal examiners. In case, the number of internal examiners falls short, external examiners may be invited. The answer scripts evaluated both by internal and external examiners shall be moderated by the external examiner / moderator.

5.2.4. The examination for Practical work/ Field work/Project work will be conducted jointly by two examiners (internal and external). However, in case of non-availability of external examiner or vice versa, the Chairperson BoE at his discretion can invite internal / external examiners as the case may be, if required.

5.2.5. If a course is fully of (L=0):T: (P=0) type, then the examination for C3 Component will be as decided by the BoS concerned.

5.2.6. In case of a course with only practical component a practical examination will be conducted with two examiners (ref: 6.3.4 above) and each candidate will be assessed on the basis of: a) Knowledge of relevant processes, b) Skills and operations involved, and c) Results / Products including calculation and reporting.

5.2.7. The duration for semester-end practical examination shall be decided by the School / Council.

**5.3. Evaluation of Minor Project / Major Project / Dissertation:**

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

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

**5.4.** The schedule of continuous assessment and examinations are summarized in the following Table below.

| Component | Period | Syllabus | Weightage | Activity |
|---|---|---|---|---|
| C1 | 1st Wk. to 8th Wk. | First 50% (two units) | 25% | Instructional process and Continuous Assessment |
| | Last 3 days of 8th Wk. | First 50% (two units) | | Consolidation of C1 |
| C2 | 9th Wk. to 16th Wk. | Second 50% (remaining two units) | 25% | Instructional process and Continuous Assessment |
| | Last 3 days of 16th Wk. | Second 50% (remaining two units) | | Consolidation of C2 |
| C3 | 17th and 18th Wk. | | | Revision and preparation for Semester end examination |
| | 19th Wk. to 20th Wk. | Entire syllabus | 50% | Conduct of semester end examination and Evaluation concurrently |
| | 21st Wk. | | | Notification of Final Grades |
| ***Evaluation shall begin very first day after completion of the conduct of examination of the first course and both examination and evaluation shall continue concurrently. The examination results / final grades be announced latest by 21st Wk.** | | | | |

**Note:** 1. Practical examination wherever applicable shall be conducted before conduct of C2 Examination. The calendar of practical examination shall be decided by the respective School.

2. Finally**, awarding of the Grades** be announced latest by 5 days after completion of the examination.

## 6.0 Requirements to Pass a Course

6.1. A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 30% marks in C1 and C2 together, and 40% and above in aggregate of C1, C2 and C3 in a course is said to be successful.

**6.2. Eligibility to Appear for C3 (Semester - end) Examination and Provision to Drop the Course.**

Only those students who fulfill 75% of attendance requirement and who secure minimum 30% marks in C1 andC2 together in a course are eligible to appear for C3 examination in that course.

6.3. Those students who have 75% of attendance but have secured less than 30% marks in C1 and C2 together in a course are not eligible to appear for C3 examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

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

6.4. In case a candidate secures more than 30% marks in C1 and C2 together but less than 40% marks in aggregate of C1, C2 and C3 in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for C3 examination during the subsequent semesters / years within the stipulated period.

In such a case wherein he / she opts to appear for just C3 examination, then the marks secured in C1 and C2 shall get continued. Repeat C3 examination will be conducted in respective semesters.

6.5. In case a candidate opts to drop the course he / she has to re-register for the dropped course only in subsequent semesters whenever it is offered if it is Hard Core Course. He / she may choose alternative course if it is Soft Core Course or Open Elective course or Skill Development Course.

**The details of any dropped course will not appear in the Grade Card.**

**6.6. Provision to Withdraw Course:**

A candidate can withdraw any course within ten days from the date of notification of final results. Whenever a candidate withdraws a course, he/she has to register for the same course in case it is hard core course, the same course or an alternate course if it is soft core/open elective. **A DROPPED course is automatically considered as a course withdrawn.**

## 7.0. Provision for Make- up Examination:

For those students who have secured less than 40% marks in C1, C2 and C3 (end semester examination) together the university shall conduct a make-up C3 examination within three Wk.s after the end of each semester.

Such of those students who have secured more than 30% marks in C1 and C2 together and less than 40% marks in C1, C2, and C3 together in a course shall appear for make-up examination in that course. This make-up examination is only for C3examination.

A student who is absent to End Semester Examination (C3) due to medical emergencies or such other exigencies and fulfills the minimum attendance and performance requirements in C1 & C2 shall appear for make-up examination.

7.1 The candidate has to exercise his/her option immediately within 10 days from the date of notification of results. A MAKE-UP examination will be conducted within 25 days from the date of notification of results. If the candidate still remains unsuccessful after MAKE-UP examination he/she is said to have DROPPED

that course

**7.2 Re-Registration and Re-Admission:**

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

In case a candidate fails in more than 2 courses in odd and even semesters together in a given academic year, he / she may either drop all the courses and repeat the semester or reappear (C3 semester end examination) to such of those courses where in the candidate has failed during subsequent semester / year within a stipulated period.

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

**7.4 Requirements to Pass the Semester andProvision to Carry Forward the Failed Subjects / Courses:**

7.4.1 A candidate who secures a minimum of 30% in C1 and C2 and 40% and above in aggregate of C1, C2 and C3 in all the courses with credits prescribed in a semester is said to have passed that semester.

**7.5. Provision to Carry Forward the Failed Subjects / Courses:**

A student who has failed in 4 courses in 1st and 2nd semesters together shall move to 3rd semester. And he / she shall appear for C3 examination of failed courses of the said semesters concurrently with 3rd semester end examinations (C3) and 4th semester end examinations (C3) of second year of study.

## 8.0 Attendance Requirement:

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

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

8.3.Any student with less than 75% of attendance in a course in aggregate during a semester shall not be permitted to appear to the end semester (C3) examination.

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

**8.5. Absence during mid semester examination**

In case a student has been absent from a mid semester examination due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher

authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher and permit such student to appear for make-up mid semester examination.

### 8.6. Absence during end semester examination:

In case a student is absent for end semester examination on medical grounds or such other exigencies, the student can submit request for make-up examination, with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School. The Director of the School may consider such request depending on the merit of the case and after consultation with class teacher, course instructor and permit such student to appear for make-up mid semester examination

**9. Provisional Grade Card:**

The tentative / provisional Grade Card will be issued by the Registrar (Evaluation) at the end of every Semester indicating the courses completed successfully.

The provisional grade card provides **Semester Grade Point Average** (SGPA).This statement will not contain the list of DROPPED courses.

**9.1 Challenge Valuation:**

A student who desires to apply for challenge valuation shall obtain a Xerox copy of the answer script by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the Grade awarded to him/her by surrendering the Grade Card and by submitting an application along with the prescribed fee to the Registrar (Evaluation) within 15 days after the announcement of the results. This challenge valuation is only for C3 component.

**The answer scripts for which challenge valuation is sought for shall be sent to another external examiner. The marks awarded will be the higher of the marks obtained in the challenge valuation and in maiden valuation.**

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

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

| Marks | Grade | Grade Point | Letter Grade |
|---|---|---|---|
| P | G | (GP=V x G) | |
| 90-100 | 10 | v*10 | O |
| 80-89 | 9 | v*9 | A |
| 70-79 | 8 | v*8 | B |
| 60-69 | 7 | v*7 | C |
| 50-59 | 6 | v*6 | D |
| 40-49 | 5 | v*5 | E |
| 0-39 | 0 | v*0 | F |

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

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

### 9.4 Computation of SGPA and CGPA

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

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

**SGPA (Si) = ∑(Ci x Gi) / ∑Ci**

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.**Illustration for Computation of SGPA and CGPAIllustration No. 1**

| Course | Credit | Grade letter | Grade Point | Credit Point (Credit x Grade) |
|---|---|---|---|---|
| Course 1 | **4** | **A** | **9** | **4X9=36** |
| Course 2 | **4** | **B** | **8** | **4X8=32** |
| Course 3 | **4** | **C** | **7** | **4X7=28** |
| Course 4 | **4** | **O** | **10** | **4X10=40** |
| Course 5 | **4** | **D** | **6** | **4X6=24** |
| Course 6 | **4** | **O** | **10** | **4X10=40** |
| | **24** | | | **200** |

Thus, **SGPA = 200 ÷ 24 = 8.33**

**Illustration No. 2**

| Course | Credit | Grade letter | Grade Point | Credit Point (Credit x Grade point) |
|---|---|---|---|---|
| Course 1 | **5** | **A** | **9** | **5X9=45** |
| Course 2 | **5** | **C** | **7** | **5X7=35** |
| Course 3 | **5** | **A** | **9** | **5X9=45** |
| Course 4 | **5** | **B** | **8** | **5X8=40** |
| Course 5 | **4** | **O** | **10** | **4X10=40** |
| | **24** | | | **205** |

Thus, **SGPA = 205 ÷ 24 = 8.54**

### 9.5 Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for two year post graduate degree in Computer Science & Engineering is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

**CGPA = ∑(Ci x Si) / ∑Ci** Where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

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

**Illustration:**

**CGPA after Final Semester**

| Semester (ith) | No. of Credits (Ci) | SGPA (Si) | Credits x SGPA (Ci X Si) |
|---|---|---|---|
| 1 | 24 | 8.33 | 24 x 8.33 = 199.92 |
| 2 | 24 | 8.54 | 24 x 8.54 =204.96 |

| | | | |
|---|---|---|---|
| 3 | 24 | 9.35 | 24x9.35=224.4 |
| 4 | 24 | 9.50 | 24x9.50=228.0 |
| Cumulative | 96 | | 857.28 |

Thus, **CGPA** = 24x8.33+24x8.54+24x9.35+24x9.50 = 8.93

**CONVERSION OF GRADES INTO PERCENTAGE:**

Conversion formula for the conversion of CGPA into Percentage is:

Percentage of marks scored = CGPA Earned x 10

**Illustration**: CGPA Earned 8.93 x 10=89.30

**9.6 Classification of Results**

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

| **CGPA** | **Numerical Index** | **FGP** |
|---|---|---|
| | | **Qualitative Index** |
| > 4 CGPA < 5 | **5** | SECOND CLASS |
| 5 > = CGPA < 6 | 6 | |
| 6 >= CGPA < 7 | 7 | FIRST CLASS |
| 7 >= CGPA < 8 | 8 | |
| 8 >= CGPA < 9 | 9 | DISTINCTION |
| 9 >= CGPA 10 | 10 | |

**Overall percentage=10*CGPA**

**10.0.Provision for Appeal**

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

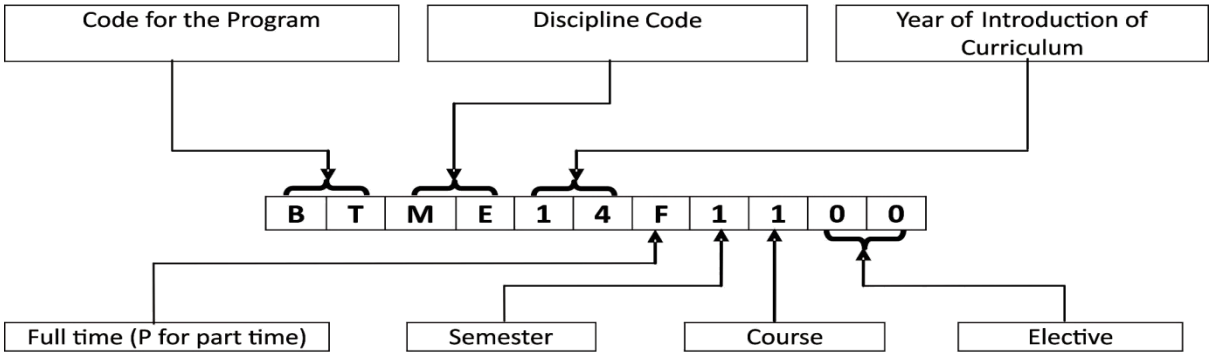
## 11.0. Grievance Cell

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

1. The Registrar (Evaluation) - Ex-officio Chairman / Convener
2. 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.
3. One Senior Faculty Members / Subject Experts drawn from outside the University school
    1. / department – Member.

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

## Course Numbering Scheme




## List of Codes for Programs and Disciplines / Branch of Study

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

**M Tech in Computer Science and Engineering (Part Time)**

**Scheme of Instruction for Academic Year 2018-2021**

| Sl. No | Course Code | Title of the Course | Course Type | Credit Pattern | | | | Hrs wee |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| **FIRST SEMESTER** | | | | | | | | |
| 1 | M18CSP1010 | Advanced Database Management Systems | HC | 4 | 0 | 1 | 5 | 6 |
| 2 | M18CSP1020 | Cloud Computing | HC | 4 | 0 | 1 | 5 | 6 |
| 3 | M18CSP1030 | Machine Learning and Deep Learning | HC | 4 | 1 | 0 | 5 | 6 |
| **Total Credits for First Semester** | | | | | | | **15** | |
| **SECOND SEMESTER** | | | | | | | | |
| 1 | M18CSP2010 | Principles of Algorithm Design (DAA) | HC | 4 | 0 | 1 | 5 | 6 |
| 2 | M18CSP2020 | Big Data and Analytics Using R | HC | 4 | 0 | 1 | 5 | 6 |
| 3 | M18CSP2030 | Internet of Things | HC | 4 | 1 | 0 | 5 | 6 |
| **Total Credits for Second Semester** | | | | | | | **15** | |
| **THIRD SEMESTER** | | | | | | | | |
| 1 | M18CSP3011 | Advanced Web Technologies | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP3012 | Advanced Storage Area Networks | | | | | | |
| | M18CSP3013 | Statistical Data Modeling and Analysis | | | | | | |
| 2 | M18CSP3021 | Image Processing | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP3022 | Mobile Application development | | | | | | |
| | M18CSP3023 | Agile Software Development | | | | | | |
| 3 | M18CSP3031 | Python Programming | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP3032 | Robotics | | | | | | |
| | M18CSP3033 | Advanced Data Structures | | | | | | |
| **Total Credits for Third Semester** | | | | | | | **15** | |

| Sl. No | Course Code | Title of the Course | Course Type | Credit Pattern | | | | Hrs /WK. |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | C | |
| **FOURTH SEMESTER** | | | | | | | | |
| 1 | M18CSP4011 | Computer Network Engineering | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP4012 | Research Methodology | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | M18CSP4013 | Open Source Cloud Computing Tools | | | | | | |
| **2** | M18CSP4021 | Unix Operating System & Internals | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP4022 | Cyber Security | | | | | | |
| | M18CSP4023 | Advanced Java Programming | | | | | | |
| 3 | M18CSP4031 | Parallel Computing and Programming | SC | 4 | 1 | 0 | 5 | 6 |
| | M18CSP4032 | Human Computer Interaction | | | | | | |
| | M18CSP4033 | Embedded Computing | | | | | | |
| **Total Credits for Fourth Semester** | | | | | | | **15** | |
| **FIFTH SEMESTER** | | | | | | | | |
| 1 | M18CSP5011 | Text and Web Mining | SC | 3 | 1 | 0 | 4 | 5 |
| | M18CSP5012 | Soft Computing | | | | | | |
| | M18CSP5013 | Wireless Networks | | | | | | |
| 2 | M18CSP5020 | Open Elective: | OE | 3 | 1 | 0 | 4 | 5 |
| 3 | M18CSP5030 | Project Phase-1 | HC | 0 | 0 | 2 | 2 | 4 |
| 4 | M18CSP5040 | MOOCS / Internship | HC | - | - | - | 3 | |
| 5 | M18CSP5050 | One Global Certification | HC | - | - | - | 3 | |
| 6 | M18CSP5060 | Sports, Yoga, Music, Dance, Theatre | RU LO | - | - | 2 | 2 | 2 |
| **Total Credits for Fifth Semester** | | | | | | | **16** | |
| **SIXTH SEMESTER** | | | | | | | | |
| 1 | M18CSP6010 | Project-Work Phase-2 and Dissertation | HC | 2 | 4 | 14 | 20 | 40 |
| **Total Credits Sixth Semester** | | | | | | | **20** | |
| **Total Credits for all Six Semesters :96** | | | | | | | | |

**Note:**

**1.** **Internship** should be carried out in a reputed /Tier-1/R & D organization, preferably, internship should be with stipend. The internship should be approved by the REVA University authorities before completion of 3rd semester and the students should obtain the permission for the same by producing the necessary details of company, selection process, and the offer letter issued by the company. At the end of the Internship, detailed report must be submitted.

**2.** Students can take-up the **internship** only if it is approved by RU authorities.

**3.** **Project work phase 1** comprises of literature survey, review paper writing, and problem formulation, identification of tools and techniques, and methodology for the project. **Project work phase – 2**, in $4^{th}$ semester should have an outcome: publication in a reputed National/International Journal or a patent filing to earn 2 credits

**4.** **Global Certification programs:** Students have to register for global certification programs of their choice such as networking, JAVA, ORACLE, etc. The students can also choose skill development programs conducted by the UIIC or School, which may not be globally certified. However, weightage is more for global certification courses (10% weightage is accounted less for non-global programs). The registration must happen before beginning of the third semester.

**I Year Detailed Syllabus**

**M. Tech in Computer Science and Engineering (Full Time)**

**First Semester**

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs/ Wk |
|---|---|---|---|---|---|---|---|---|
| M18CSP1010 | Advanced Database Management Systems | 16 | HC | 4 | 0 | 1 | 5 | 6 |

**Course Objectives:**

The objectives of this course are to:

1. Introduce the Object oriented concepts and object relational Databases;
2. Acquire knowledge on parallel and distributed databases and its applications;
3. Study the concepts of advanced databases like Data Warehousing and Data Mining;
4. Learn emerging and advanced data models;

**Course Outcomes:**

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

CO1: Solve queries using SQL for real world applications.

CO2: Make use of the Object oriented concepts in relational databases for real world applications.

CO3: Design parallel and distributed databases, Query database and incorporate recovery mechanisms.

CO4: Develop Enhanced Data Model for given real world applications.

**Course Contents:**

**Unit 1**
**Introduction to DBMS: Basics of DBMS and SQL**

**Unit- 2**
**Overview of Object-Oriented Concepts, Object and Object-Relational Databases:** Objects, Encapsulation, Polymorphism, Type and class hierarchies etc. Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; Conceptual design of Object database; Overview of object relational features of SQL; Object-relational features of Oracle.

**Unit -3**
**Parallel and Distributed Databases:** Architectures for parallel databases; Parallel query evaluation; Parallelizing individual operations; Parallel query optimizations; Introduction to distributed databases; Distributed DBMS architectures; Storing data in a Distributed DBMS; Distributed catalog management; Distributed Query processing; Updating distributed data; Distributed transactions; Distributed Concurrency control and Recovery.

**Unit- 3**
**Data Mining:** Introduction to decision support, OLAP, multidimensional model, Window queries in SQL,

Finding answers quickly, Implementation techniques for OLAP, Data Warehousing, Introduction to Data Mining, Counting co-occurrences, Mining for rules, Tree-structured rules, Clustering, Similarity search over sequences, Incremental mining and data streams**;**

**Unit- 4**

**Enhanced Data Models for Some Advanced Applications:** Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

**Recommended Learning Resources:**


1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw-Hill, 2003.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.
3. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier, 2011.
4. Connolly and Begg, Database Systems, 4th Edition, Pearson Education, 2002.
5. Journal of Data and Information Quality (JDIQ)
6. ACM Transactions on Knowledge Discovery from Data (TKDD)
7. ACM Transactions on Database Systems (TODS)
8. ACM Transactions on Storage (TOS)
9. IEEE Transactions on Knowledge and Data Engineering


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 2 | 1 | | | | | 1 | 1 | 1 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 2 | | | | | 1 | 1 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 1 | 2 | | | | | | 2 | 1 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | 1 | 1 | 3 | 3 |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

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| Course Code | Course Title | Duration (Week) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP1020 | Cloud Computing | 16 | HC | 4 | 0 | 1 | 5 | 6 |

**Prerequisites:**

Students should have basic knowledge about Computer Networks and Operating System.

**Course Objectives:**

The objective of this course is to:

1. Provide knowledge in different layers of cloud computing, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS);
2. Compare and contrast different Cloud service delivery models.
3. Illustrate the use of various cloud computing technologies;
4. Provide Introduction to cloud security and secure computation in the cloud.

**Course Outcomes:**

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

CO1: Analyze the distinctions between Infrastructure, Platform and Software as a Service (IaaS, PaaS, SaaS) abstractions

CO2: Analyze the advantages and disadvantages of Public and Private Clouds and apply it for different scenarios.

CO3: Develop and deploy cloud application using popular cloud platforms

CO4. Design Cloud security solutions

**Course Contents:**

**Unit 1:**

**Introduction to Cloud Computing:** Origins and Influences; Basic Concepts and Terminology; Goals and Benefits; Risks and Challenges.

**Fundamental Concepts and Models:** Roles and Boundaries; Cloud Characteristics; Cloud Delivery Models; Cloud Deployment Models.

**Unit 2:**

**Cloud Enabling Technologies:** Broadband Networks and Internet Architecture; Data Center Technology; Virtualization Technology; Web Technology; Multitenant Technology; Service Technology.

**Cloud Infrastructure Mechanisms:** Logical Network Perimeter; Virtual Server; Cloud Storage Device; Cloud Usage Monitor; Resource Replication; Ready-made environment

**Unit 3:**

**Specialized Cloud Mechanisms:** Automated Scaling Listener; Load Balancer; SLA Monitor; Pay-per-use Monitor; Audit Monitor; Failover System; Hypervisor; Resource cluster; Multi-device Broker; State Management Database

**Cloud Management Mechanisms:** Remote Administration System; Resource Management System; SLA Management System; Billing Management System.

**Unit 4:**

**Cloud Security:** Basic Terms and Concepts; Threat Agents; Cloud Security Threats; Additional Considerations.

**Cloud Security Mechanisms:** Encryption; Hashing; Digital Signature; Public Key Infrastructure; Identity and Access Management; Single-Sign-on; Cloud-based Security Groups; Hardened Virtual Server Images.

**Recommended Learning Resources:**


1. Thomas Erl , Ricardo Puttini , ZaighamMahmood Cloud Computing: Concepts, Technology & Architecture PHI, 2013.
2. Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, Distributed and Cloud Computing,MK,2012.
3. DharanipragadaJanakiram, Grid and Cloud Computing, McGraw-Hill 2016.


**References:**


1. Dan C. Marinescu, Cloud Computing: Theory and Practice, MK
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. RajkumarBuyya, JamesBroberg, AndrzejGoscinski, Cloud Computing- Principles and Pradigms,Wiley.
4. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Cloud Computing, A practical approach, TATA McGRAW HILL.
5. Gautam Shroff, Enterprise Cloud Computing- Technology, Architecture, Applications, CAMBRIDGE.
6. David Marshall, Wade A. Reynolds and Dave McCrory, Advanced Server Virtualization-VMware and Microsoft Platforms in the Virtual Data Center, AUERBACH Publications.
7. Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.
8. International Journal of Cloud Computing, INDERSCIENCE Publishers.
9. IEEE Cloud Computing
10. International Journal of Cloud Applications and Computing (IJCAC), IGI Global.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | **1** | **3** | **3** | **2** |
| CO2 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | **1** | **3** | **3** | **2** |
| CO3 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | **1** | **3** | **3** | **2** |
| CO4 | 2 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | **1** | **3** | **3** | **2** |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Week) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP1030 | Machine Learning and Deep Learning | 16 | HC | 4 | 1 | 0 | 5 | 6 |

**Prerequisites:**

Students must have studied Data Structure, Algorithms and Mathematics

**Course Objectives:**

The objectives of this course are to:

1. Understand the basic theory underlying machine learning.
2. Illustrate the applications of machine learning algorithms to solve problems of moderate complexity for data analysis.
3. Explain the Neural Network a biologically-inspired programming paradigm which enables a computer to learn from observational data.
4. Impart the knowledge of Deep learning, a powerful set of techniques for learning in Neural Networks.

**Course Outcomes:**

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

CO1:.Design a Learning Model for any real time applications.

CO2: Understand supervised and unsupervised learning

CO3: Perceive how to apply Neural Networks.

C04: Apprehend how to perform evaluation of learning algorithms and Deep Learning.

**Course Contents:**

**Unit-1**

**Introduction**: Well-Posed Learning Problems, Designing a Learning System, Perspectives and Issues tin Machine Learning Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, and Reinforcement Learning. Supervised Learning. Concept Learning and the General-to-Specific Ordering.

**Unit-2**

Dimensionality Reduction: Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis. Clustering: Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters. Decision Tree Learning,

**Unit-3**

Characteristics of Neural Networks, Historical Development of Neural Networks Principles, Artificial Neural Networks: Terminology, Models of Neuron, Topology, Basic Learning Laws, Pattern Recognition Problem, Basic Functional Units, Pattern Recognition Tasks by the Functional Units. Feedforward Neural Networks: Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks,

**Unit-4**

Deep Feed forward Networks: Example learning XOR, Gradient based learning, Hidden units, Architectural design, Back propagation and other differential algorithms

**Recommended Learning Resources:**


1. Machine Learning Tom Mitchell: McGraw-Hill Chapters 1, 2, 3, 4, 6, 8, 9.1 to 9.4, 13
2. Introduction to Machine Learning Ethem Alpaydin: Second edition MIT press Chapters 1, 2, 6, 7, 19
3. Artificial Neural Networks B. Yagna Narayana, PHI
4. Deep Learning -Ian Good fellow, Yoshua Bengio and Aaron Courville.An MIT Press book
5. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
6. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc., 2001
7. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 3 | 3 | | | | | | | **2** | **2** | **1** |
| CO2 | 2 | 2 | 2 | 3 | 3 | | | | | | | **3** | **2** | **1** |
| CO3 | 3 | 3 | 3 | 3 | 2 | | | | | | | **2** | **2** | **1** |
| CO4 | 3 | 2 | 3 | 2 | 3 | | | | | | | **2** | **2** | **1** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3011 | **Advanced Web Technologies** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Course Objectives:**

The objectives of this course are to:

1. Introduce server-side Web technologies.
2. Impart knowledge about the concepts, design and basic coding of advanced Web applications such as ASP, JSP, .NET, Perl, CGI and other server side technologies,
3. Create and revise a multimedia web; integrate basic database functions;
4. Enable publishing to multiple servers, XML, XSLT, SHTML, and Cascading Style Sheets may be utilized.
5. WAP Architecture, WAP stack and emerging technologies on mobile devices.

**Course Outcomes:**

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

CO 1: Illustrate the fundamentals and advanced concepts in the area of web services

CO 2: Apply servlets Concepts like Servlet classes and Threading to build web applications.

CO 3: Utilize Web Service Architectures to build web services for agriculture applications.

CO 4: Outline various WAP Applications used in medical system.

**Course Contents:**

**Unit- 1**

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

**Unit- 2**

**Servlets:** Introduction to servlets, Servlet life Cycle, Servlet classes, Threading Models Http Sessions.

**Unit- 3**

**Introduction to web services:** What is a Web Service? Software as a service, Web Service Architectures, SOA, XML,

**Unit 4**

**Limitations of Mobile Devices** WAP Architecture , WAP stack. Online Applications and emerging technologies , Online Shopping , Online databases , Monitoring user events , Need for NET , Overview of NET Framework , Web services.

**Recommended Learning Resources:**


1. Robert W. Sebesta, Programming the World Wide Web, Pearson Education 2008.
2. Web warrier guide to web programming, Bai,Hue, others, Thomson/Course Technology, 2003
3. Internet and World Wide Web How To Program, Deitel P, Deitel HM, Pearson Education, 2012
4. AchyutS. Godbole and AtulKahate, Web Technologies, Tata McGraw Hill, 2003.
5. Jason Hunter, William Crawford, Java Servlet Programming, O'Reilly Publications, 1998.
6. Paul S Wang, SandaKatila An introduction to Web design and programming Cengage Course, 2003.
7. ACM Trans on Internet Technology
8. IEEE International Conference on Enterprise Computing and E-Commerce.
9. ACM Transactions on Information Systems.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 2 | 2 | 2 | 1 | 2 | **1** | | | | | | **3** | **3** | **2** |
| CO2 | 2 | 3 | 2 | 2 | 3 | **1** | | | | | | **3** | **3** | **2** |
| CO3 | 2 | 3 | 3 | 3 | 3 | **1** | | | | | | **3** | **3** | **2** |
| CO4 | 2 | 3 | 2 | 2 | 3 | **1** | | | | | | **3** | **3** | **2** |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO , PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./ Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CS1042 | Advanced Storage Area Networks | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Course Objectives:**

The Objective of this course is to provide an understanding of the need for SAN, caching, local file systems, SAN hardware, and SAN Architecture on going through this course.

**Course Outcomes:**

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

1. Identify the need for performance evaluation and the metrics used for it
2. Apply the techniques used for data maintenance.
3. Realize storage virtualization concept
4. Develop techniques for evaluating policies for LUN masking, file systems

**Course Contents:**

**Unit 1**:

**Server Centric IT Architecture and its Limitations; Storage:** Centric IT Architecture and its advantages; Case study: Replacing a server with Storage Networks; The Data Storage and Data Access problem; The Battle for size and access. Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID and different RAID levels;

**Unit2:**

**Caching:** Acceleration of Hard Disk Access; Intelligent disk subsystems; Availability of disk subsystems. The Physical I/O path from the CPU to the Storage System; SCSI.

Fiber Channel Protocol Stack; Fiber Channel SAN; IP Storage The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system.

**Unit 3:**

**Local File Systems:** Network file Systems and file servers; Shared Disk file systems; Comparison of fiber Channel and NAS, Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network

**Unit 4:**

**Overview, creating a Network for storage:** SAN Hardware devices, the fiber channel switch, Host Bus adaptors; putting the storage in SAN; Fabric operation from a Hardware perspective. The switch's Operating system, Device Drivers, The Supporting the switch's components, Configuration options for SANs. Panning for business continuity.

**Recommended learning resources:**


1. U. Troppens, R. Erkens and W. Muller, *Storage Networks Explained*, John Wiley and Sons, 2003.
2. R. Spalding, *Storage Networks: The Complete Reference*, Tata McGraw Hill, 2003.
3. R. Barker and P. Massiglia, *Storage Area Network Essentials: A Complete Guide to understanding and Implementing SANs*, John Wiley India, 2002.
4. M. Farley, *Storage Networking Fundamentals*, Cisco Press, 2005.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 1 | 3 | 2 | 2 | 3 | 1 | | | | | | | 3 | |
| CO2 | 3 | 2 | 1 | 3 | 3 | 2 | | | | | | | 3 | |
| CO3 | 1 | 3 | 2 | 2 | 3 | 1 | | | | | | | 3 | |
| CO4 | 2 | 1 | 2 | 3 | 3 | 1 | | | | | | | 3 | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CS1043 | Statistical Data Modelling and Analysis | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Course Objectives:**

The objectives of this course are to:

1. Explore and characterize their data, including defining the mean, median, uncertainties, and factors that contribute to variance.
2. Describe how to propagate errors in calculations of derived quantities and perform formal hypothesis testing in interpreting data.
3. Make Use of basic concepts of linear algebra and least squares formalism for curve fitting and regression.
4. Explore various ways to examine sequential or time-series data, including using spectral analysis.

**Course Outcomes:**

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

CO1: Apply technical knowledge of mathematics and physics to solve real-world computer applications in geology and geophysics
CO2: Describe the propagation of errors in calculations of derived quantities and perform formal hypothesis testing in interpreting data.
CO3: Make use of scientific method to define, analyse, and solve a problem in earth science.
CO4: communicate scientific knowledge in both oral presentations and in writing

**Course Contents:**

**Unit- 1**

**Exploring Data & Error Analysis**; Classification of data, exploratory data analysis, Error Analysis; Reporting uncertainties, significant figures, & errors of sums & general functions, Uncertainties of products, quotients, and examples.

**Basic Concepts in Statistics ;** Probability Basics, Permutations, Combinations, Binomial probability distribution, Hyper geometric distribution, Some Rules of Probability, Additional rules, Conditional Probability, Conditional Probability and Bayes Theorem

**M&M's of Statistics**; Population and Samples, Measure of central location (mean, median, mode), Probability Distributions and Inference about the mean and Central Limits Theorem Probability Distributions, Binomial and Normal Distributions, The Normal (Gaussian) Probability Density Function, Applications of the Normal Distribution & the Poisson's Distribution, Inferences about means of populations.

**Unit- 2**

**Hypothesis Testing;** Null Hypothesis, Videos, Parametric Tests (Students *t*, Chi-squared, *F* tests), One and two sample test of means Tables: normal distribution, t-distribution, chi-squared, F-distribution

**Non-Parametric Tests;** Parametric vs. Non-Parametric tests, **Sign** test of central value, **Mann**-Whitney 2-sample U test of median, Tables: Mann-Whitney, K-S (1-sample), K-S (2-sample).

**Unit- 3**

**Regression;** Line Fitting Revisited, Confidence Intervals on True Slope, Intercept, and Regression Line, Derivation of Variances of True Slope, Intercept, and Regression Line.

**Analysis of Variance (ANOVA);** Analysis of Variance (ANOVA) of Linear Regression, **ANOVA,** One-way ANOVA, Two-way ANOVA.

**Unit 4**

**Sequences and Time Series Analysis;** Markov Chains, Auto correlation, with data for auto- and cross-correlation, Autocorrelation and Cross-Correlation.

**Spectral Analysis;** Spectral Analysis: Basic Terminology, Introduction to spectral analysis, Orthogonally of periodic functions, Spectral Analysis. Spectral Analysis: Fitting the Fourier Series, Periodogram or Discrete Power Spectrum.

**Recommended Learning Resources:**

1. Introduction to Statistics and Data Analysis, by Paul Wessel. Recommended (optional) text: John C. Davis, Statistics and Data Analysis in Geology, 3rd Edition
2. A Abebe, J Daniels, et al., Statistics and Data Analysis.

Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 1 | 2 | 0 | 0 | | | | | 3 | | |
| CO2 | 3 | 3 | 3 | 2 | 2 | 1 | 0 | | | | | | 2 | |
| CO3 | 3 | 2 | 2 | 2 | 3 | 0 | 0 | | | | | | | 3 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3021 | **Image Processing** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Course Objectives**

The objectives of this course are to:

1. Discuss the image fundamentals and mathematical transforms necessary for image processing.
2. Discuss the different Image restoration methods.
3. Analyze Image enhancement in both the spatial and frequency domains.

**IMAGE RESTORATION**

4. To analyze the constraints in image processing when dealing with 3D data sets.

**Course Outcomes**

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

1. Understand image formation and the role human visual system play in perception of gray and color image data.
2. Apply image processing techniques in both the spatial and frequency domains.
3. Conduct independent study and analysis of feature extraction techniques.
4. Demonstrate color Fundamentals in color image processing.

**Course Contents**

**Unit- 1**

**INTRODUCTION TO IMAGE PROCESSING**: What is Digital Image Processing, Origins of Digital Image Processing, examples of fields that use DIP, Fundamental Steps in Digital Image Processing and Components of an Image Processing system. Digital Image Fundamentals: Elements of Visual Perception, Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images.

**Unit- 2**

**IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN**: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters.

**Unit- 3**

**IMAGE RESTORATION**: A Model of the Image degradation/Restoration process, Noise

Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering.

**Unit-4**

**COLOR FUNDAMENTALS AND IMAGE COMPRESSION**: Color Models, Pseudocolour Image Processing, Basics of Full Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Fundamentals ,Some basic methods: Huffman coding, Arithmetic coding, Symbol-based coding, Bit- plane coding, Predictive coding, Digital image watermarking

**Recommended Learning Resources**


1. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, PHI 2nd Edition 2005
2. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004.
3. Scott.E.Umbaugh: Digital Image Processing and Analysis, CRC Press, 2014.
4. S.Jayaraman, S.Esakkirajan, T.Veerakumar: Digital Image Processing, McGraw Hill, 2013.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 1 | 2 | 2 | 1 | 2 | | | | | | | 2 | 2 | 2 |
| CO2 | 2 | 3 | 3 | 3 | 2 | | | | | | | 1 | | |
| CO3 | 2 | 2 | 2 | 3 | 3 | | | | | | | 1 | 1 | |
| CO4 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 2 | 2 |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./ Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3022 | **Mobile Application Development** | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Prerequisite:**

Basic Programming Language

**Course Objectives:**

The objectives of this course are to:

1. Analyze system requirements for mobile applications.
2. Apply of mobile development frameworks.
3. Demonstrate mobile application design.
4. Demonstrate and implement mobile application.

**Course Outcomes:**

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

1. Describe the requirements for mobile applications
2. Explain the challenges in mobile application design and development
3. Develop design for mobile applications for specific requirements
4. Implement the design using Android SDK
5. Implement the design using Objective C and iOS
6. Deploy mobile applications in Android and iPone marketplace for distribution

**Course Contents:**

**Unit-1:**

**Introduction to mobile communication and computing:** Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications.

**Unit-2:**

**Fundamentals of Android Development:** Introduction to Android., The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator.

**Unit-3:**

**The Intent of Android Development, Four kinds of Android Components:** Activity, Service, Broadcast Receiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating

Animation with Android's Graphics API.

**Unit-4:**

**Creating the Activity, Working with views:** Exploring common views, using a list view, creating custom views, understanding layout. Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments. Multimedia: Playing Audio, Playing Video and Capturing Media. Advanced Android Programming: Internet, Entertainment, and Services.

**Recommended Learning Resources:**


1. Mobile Computing: technologies and Applications-N. N. Jani S Chand
2. B. M. Hirwani- Android programming Pearson publications-2013
3. W. Frank Ableson, Robi Sen and C. E. Ortiz - Android in Action, Third Edition-2012 DreamTech publisher
4. IJIM, International Journal of Interactive Mobile Technologies


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 2 | 1 | 1 | | 1 | 2 | **2** | **1** | **3** | **1** | **3** |
| CO2 | 3 | 3 | 2 | 3 | 2 | 2 | | 2 | 3 | **2** | **1** | **3** | **3** | **3** |
| CO3 | 1 | 2 | 3 | 1 | 2 | 1 | | 1 | 3 | **2** | **2** | **3** | **3** | **2** |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | | 2 | 2 | **2** | **1** | **3** | **2** | **3** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3023 | **Agile Software Development** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Prerequisite:**

Software Engineering

**Course Objectives:**

The objectives of this course are to:

1. Describe the approaches, advantages, and disadvantages of both traditional and agile project methodologies; assess the stakeholder environment and tailor the deliverables accordingly.
2. Explain an agile project management plan that includes the typical steps, activities, and participant roles for an agile project, and evaluate how and when these agile characteristics can be integrated with steps from a traditional project management life cycle to achieve an effective hybrid approach.
3. Discuss the appropriate tools and resources for agile projects, including specific and adapted metrics that can assist the project manager in defining, executing, and controlling projects that follow an agile, or hybrid, lifecycle and methodology.
4. Understand the core principles, practices that are part of a DevOps implementation and culture.
5. Understand the enormous benefits that organizations would gain by implementing DevOps practices and culture.

**Course Outcomes:**

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

1. Explain and justify the need for agile project management methodologies.
2. Compare and contrast the benefits/costs of agile versus traditional project management methodologies.
3. Assess, plan, deliver, confirm, and track agile project value.
4. Apply tools and techniques to engage stakeholders and keep them interested throughout the project.
5. Define, initiate, plan, execute, monitor/control, and close and agile project by engaging in a simulation using the Scrum methodology.
6. Deepen their knowledge, achieve a mutual understanding for the DevOps framework and strengthen their social competencies in collaboration and improvement.

**Course Contents:**

**Unit-1:**

**Introduction**: Iterative Development, Risk-Driven and Client-Driven Iterative Planning,Time boxed Iterative Development, Evolutionary and Adaptive Development, Evolutionary Requirements Analysis, Early “Top Ten” High-Level Requirements and Skillful Analysis, Evolutionary and Adaptive Planning. Incremental Delivery, Evolutionary Delivery.

**Unit-2:**

**Agile:** Agile Development, Classification of Methods, The Agile Manifesto and Principles, Agile Project Management, Embrace Communication and Feedback, Programming as If People Mattered, Simple Practices and Project Tools, Empirical vs. Defined & Prescriptive Process, Principle-Based versus Rule-Based. Sustainable Discipline: The Human Touch, Team as a Complex Adaptive System, Agile Hype? Specific Agile Methods.

**Unit-3:**

**Motivation:** The Facts of Change on Software Projects, Key Motivations for Iterative Development, Meeting the Requirements Challenge Iteratively, Problems with the Waterfall.
**Evidence:** Research Evidence, Early Historical Project Evidence, Standards-Body Evidence, Expert and Thought Leader Evidence, Business Case for Iterative Development.

**Unit-4:**
**Fundamentals :** Beginning DevOps for Developers, Introducing DevOps, Building Blocks of DevOps.
**Metrics and Measurement View :** Quality and Testing, Process view.
**Technical View :** Automatic Releasing, Infrastructure as Code, Specification by Example**.**

**Recommended Learning Resources:**


1. Craig Larman;*Agile and Iterative Development: A Manager's Guide*. Pearson Education; 2003.
2. Robert Cecil Martin;*Agile Software Development: Principles, Patterns, and Practices*; Prentice Hall PTR, Upper Saddle River, NJ, USA; 2003.
3. Michael Huttermann; DevOps for Developers, Integrate Development and Operations, The Agile Way, Apress Publications. (https://books.google.co.in/ )


**References:**


1 IEEE, The IEEE Transactions on Smart Grid
2 Elsevier, e-book on Agile Development and Business Goals


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 2 | 2 | | | | | | | **2** | **3** | |
| CO2 | 3 | 2 | 2 | 3 | 3 | | | | | | | **2** | **3** | |
| CO3 | 3 | - | 3 | 3 | 2 | | | | | | | **2** | **3** | |
| CO4 | 3 | 2 | 3 | 3 | 2 | | | | | | | **2** | **3** | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO , PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3031 | **Python Programming** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Course Objectives:**

**The objectives of this course are to:**

1. Discuss scripting tools – Groovi, NodeJs, AngularJS
2. Implement basic programs in Python programming.
3. Explain python lexical features and syntax of python structures and flow control
4. Illustrate the use of python functions files and exceptions

**Course Outcomes:**

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

1. Explain the potential of scripting technologies in building cutting edge web based systems
2. Analyze and model requirements and constraints for the purpose of designing and implementing software systems in Python;
3. Design and implement Python software solutions that accommodate specified requirements and constraints, based on analysis or modeling or requirements specification.
4. Design and develop GUIs in Python

**Course Contents:**

**Unit- 1**

Introduction to Scripting – Difference between scripting and programming languages, Basics of Groovy –Basic Syntax, Datatypes, Variables, Operators, Loops, Decision Making. Basics of NodeJs- What is nodeJs, Features, Uses, NodeJS local environment setup, installation, first nodejs application, Basics of Angular JS –Features, Advantages, Directives, Environment, First application.

**Unit-2**

**Getting started**: Introducing python, setting up python on windows and other operating systems, introducing IDLE. Data types, variables, assignment operators, expressions; basic I/O, using quotes with strings, using escape sequences with strings, concatenating and repeating strings, working with numbers, user input, right types, converting values. Branching, using the if, else, else-if statements, Creating and running Python source files (.py)

**Unit -3**

**For loops, strings and tuples**: while loops, using for loops, values as conditions, compound conditions, using sequence operators and functions with strings, indexing strings, string immutability, building a new string, slicing strings, tuples. Lists and dictionaries – using Lists, list methods, understanding when to use tuples and lists, nested sequences, shared references, dictionaries, hangman game. Functions, creating functions, parameters and return values, keyword arguments, default parameters, global variables, tic-tac toe game.

**Unit- 4**

**Files and Exceptions**: reading and writing to text files, storing complex data, handling exceptions. Software objects, caretaker program, object oriented basics, creating classes, methods and objects, constructors, attributes, class attributes.

GUI development -understanding event driven programming, root window, labels, buttons, creating a GUI using a class, binding widgets and event handlers, text and entry widgets and Grid layout manager, check buttons, radio buttons, creating a graphics window.

**Recommended Learning Resources:**


1. Python Programming for absolute beginners, Michael Dawson, 3rd Edition, Course technology PTR, 2010.
2. Learn Python the Hard Way, Zed D Shaw, 3rd Edition, Addison Wesley
3. Learning to Program with Python, Richard L. Halterman,2011
4. Mark Lutz , Python Programming, Shroff Publishers & Distributors, 2011
5. Programming Groovy 2: Dynamic Productivity for the Java Developer Book by Venkat Subramaniam, Oreilly Media
6. Node.js, MongoDB and AngularJS Web Development Book by Brad Dayley
7. Web Site Link : https://www.python.org/
8. http://python.berkeley.edu/resources/
9. https://learnpythonthehardway.org/


**Suggested Programming Exercises:**

1. Output 3-letter month name given the month number using strings;
2. Convert a date in the d/m/y format (d, m and y are day month and year respectively as numbers) to a given (fixed) format;
3. Take the principal amount and the term of a loan and print the EMI.
4. Convert a number in words to numeric.
5. Random Number Generator.
6. Binary Search;
7. Simulate a queue;
8. Find the average of all the input numbers until a prompt;
9. Invert a string;
10. Find the square root of a number using Newtons method where the iterative formula is given;
11. Convert roman numerals to decimal and vice versa;
12. Answer simple questions with a fixed structure (e.g. Is the dolphin a mammal?) using an associative list as a "database" of animals with their classification
13. Solve the Koenigsburg Problem on graphs;
14. Write a decoder for a text that has been encrypted using a Caesar cypher.
15. Creating a Unix-style find with parameters acting as filters on the file attributes.
16. Simple transliteration of an Indian language text into another Indian language; Simple Natural Language Interface to the Unix file system.
17. Complete the compression and extraction programs based on Huffman code.
18. Implement a naive RSA encryption-decryption.
19. Operations on sparse matrices.
20. Make a bouncing balls program draws a set of "walls" of arbitrary sizes and orientations and creates a few (1-3) balls with randomly chosen initial velocities and let them bounce around in a manner consistent with the physical laws of motion.

Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 3 | 3 | | | 1 | | | | 1 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 2 | | | 1 | | | | 1 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | | | 1 | | | | 2 | 3 | 3 |
| CO4 | 3 | 3 | 2 | 3 | 3 | | | 1 | | | | 2 | 3 | 3 |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO , PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3032 | **Robotics** | **16** | SC | 4 | 1 | 0 | 5 | 6 |

**Prerequisite**

Coding algorithms, Electronics circuitry, control systems

**Course Objectives**

The objectives of this course are to:

1. Discuss the fundamentals of Robotics.
2. Explain intelligent module for robotic motion control.
3. Demonstrate robotic vision system using transformation techniques.
4. Illustrate the working of innovative robotic devices.

**Course Outcomes**

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

1. Outline the fundamentals and architecture of robotics.
2. Design an Intelligent module for robotic motion control.
3. Develop robotic vision system using transformation techniques and sensors.
4. Make use of innovative robotic devices for industrial and socially relevant applications.

## Course Contents

**Unit 1: Basic Concepts of Robotics**

Introduction, Advantages and Applications of Robots, Basic structure of robots, Numerical controls Machine tools, Resolution, accuracy and Repeatability, Position representation, Specifications of Robot, Speed of Robot-Robot joints and links, Robot classifications

**Unit 2: Controls and End Effectors**

Control system concepts – Analysis, control of joints, Adaptive and optimal control – End effectors , classification , Mechanical , Magnetic ,Vacuum , Adhesive , Drive systems and controls, Force analysis and Gripper design.

**Unit III-Robot Transformations and Sensors**

Robot kinematics-Types- 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems.

**Sensors in robot** – Touch sensors, tactile sensor, Proximity and range sensors – Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

**Unit IV Robot Cell Design and Applications**

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, NXT Software Introductions-Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot.

**Micro/Nano Robotics System**: Micro/Nanorobotics system overview-Scaling effect-Top down and bottom up approach- Actuators of Micro/Nano robotics system

**Recommended Learning Resources**


1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002
2. Koren, Yoram,. Robotics for engineers. Vol. 168. New York et al: McGraw-Hill, 1985.
3. Mikell P. Groover, Mitchell Weiss, "Industrial Robotics, Technology, Programming and Applications ", McGraw Hill International Editions, 1st Edition, 2000
4. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control Sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
5. Deb S.R., " Robotics Technology and Flexible Automation ", Tata McGraw-Hill, Publishing Co., Ltd., 1994.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | **2** | **3** | **2** |
| CO2 | 3 | 3 | 3 | 3 | 3 | | | | | | | **2** | **3** | **2** |
| CO3 | 3 | 3 | 3 | 3 | 3 | | | | | | | **2** | **3** | **2** |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | | **2** | **3** | **2** |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP3033 | **Advanced Data Structures** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Prerequisites**

Concept of Dynamic Memory Allocation, Algorithm Specification, Any one procedure oriented-Programming Language and basic Engineering Mathematics

**Course Objectives**

The objectives of this course are to:

1. Discuss the basic topics Arrays , Structures, Multiple stacks and queues.
2. Implement linked lists, Trees and graphs in any programming Language.
3. Design and implementation of priority queues and search trees
4. Compare and contrast various data structures for various applications

**Course Outcomes**

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

1. Design trees, balanced trees, hash sets, and graph structures.
2. Apply various data structures depending on the application at hand.
3. Comprehend the significance of data structures in the design of algorithms.
4. Implement and Analyze concurrent linked lists, stacks, and queues.

**Course Contents**

**Unit- 1**
**ARRAYS and STRUCTURES**: Arrays, Dynamically Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Representation of Multidimensional Arrays Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues.

**Unit- 2**
**LINKED LISTS:** Singly Linked lists and Chains, Representing Chains, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists

**Unit- 3**
**TREES & GRAPHS:** Introduction, Trees, Binary Trees, Properties and representation of binary trees, Common binary tree operations, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Representation of Disjoint Sets, Counting Binary Trees, The Graph Abstract Data Type, Dictionaries, Linear representation, Skip list presentation, Hash table representation.

**Unit- 4**
**PRIORITY QUEUES & SEARCH TREES:** Single- and Double-Ended Priority Queues, Leftist

Trees, Binomial Heaps, Fibonacci Heaps, Pairing Heaps. Efficient Binary Search Trees, Optimal Binary Search Trees, AVL Trees, Red-Black Trees, Splay Trees.

**Recommended Learning Resources**


1. Horowitz, Sahni, Anderson-Freed: Fundamentals of Data Structures in C, 2nd Edition, Universities Press, 2007.

2.Data structures, Algorithms, and applications in C++ - SartajSahni, McGraw Hill, 2000.

3. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.

4. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009.

5. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, Cengage Learning, 2005.

6. Journal of Experimental Algorithmics (JEA)

7. ACM Transactions on Algorithms (TALG)


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | **3** | **3** | **2** |
| CO2 | 3 | 2 | 3 | 3 | 3 | | | | | | | **2** | **3** | **2** |
| CO3 | 3 | 2 | 3 | 3 | 3 | | | | | | | **3** | **3** | **2** |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | | **3** | **3** | **2** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO , PO and PSO

## Second Semester

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP2010 | Principles of Algorithm Design | 16 | HC | 4 | 0 | 1 | 5 | 6 |

**Course Objectives:**

The objectives of this course are to:

1. Provide a solid foundation in algorithm design and analysis;
2. Analyze the asymptotic performance of algorithms.
3. Apply important algorithmic design paradigms and methods of analysis.
4. Synthesize efficient algorithms in common engineering design situations.

**Course Outcomes:**

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

1. Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate, and analyze them.
2. Design and deploy various Polynomials, FFT, Probabilistic and randomized algorithms;
3. Analyze worst-case running times of algorithms using asymptotic analysis;
4. Prove the correctness of algorithms using inductive proofs and invariants;
5. Analyze randomized algorithms with respect to expected running time, probability of error using tail inequalities;
6. Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms;
7. Design and Implementation of algorithms in C, C++.
8. Gain a good understanding on a wide range of advanced algorithmic problems,

   their Relations and variants, and application to real-world problems.

**Course Contents:**

**UNIT – 1**

**Review of Fundamentals:** Algorithms from Ancient to Modern Times – Toward a modern Theory of Algorithms – Computing in the Third Millennium – Guidelines for Algorithm Design – Recursion – Data Structures and Algorithm Design – Major Design Strategies – Analyzing Algorithm Performance – Designing and Analyzing some basic comparison based list algorithms – Asymptotic behavior of Functions – Asymptotic order formulae for three important series – Recurrence relations forcomplexity – Mathematical induction and proving the correctness of algorithms – Establishing lower bounds for problems.

**UNIT – 2**

**Trees & Applications to Algorithms:** Mathematical properties of Binary trees – implementation of trees and forests – Tree traversal – Binary search trees – Priority queues and heaps – Implementing disjoint sets – Shellsort – Bingosort – Radixsort – External sorting

**UNIIT – 3**

**Graph & Network Algorithms:** Graphs and Digraphs – Bipartite Matching – Maximum flow problem – Ford-Fulkerson Algorithm – Maximum Flows and Minimum Cuts in Network – Choosing Good Augmenting Paths – Preflow-Push Maximum-Flow Algorithm – Bipartite matching problem – Disjoint Paths in directed and undirected graphs – Survey design – Airline Scheduling – Image segmentation – Projection Selection – Baseball Elimination – Adding Costs to the matching problem

**UNIT – 4**

**Extending the Limits of Tractability:** Finding small vertex covers – Solving NP-Hard problems on Trees – Coloring a set of circular arcs – Tree decompositions of Graphs – Properties of tree decompositions – Dynamic programming over a tree decomposition – Constructing a tree decomposition

**Recommended Learning Resources:**


1. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson, 2016
2. Kenneth A. Berman, Jerome L. Paul, Algorithms, Cengage Learning, 2008.
3. T. H. Cormen, C. E Leiserson, R. L. Rivest and C Stein, Introduction to Algorithms, 3rd Edition, Prentice- Hall of India, 2010.
4. Anany Levitin, Introduction to the Design & Analysis of Algorithms, Pearson, 2013
5. Ellis Horowitz, SartajSahni, S. Rajasekharan, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2007.
6. J. Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005.
7. V. Aho, J. E. Hopcraft, and J. D. Ullman, Design and Analysis of Algorithms, Addison-Wesley, 1974.
8. ACM Transactions on Algorithms
9. ACM Transactions on Modeling and Computer Simulation (TOMACS)
10. Transactions on Parallel and Distributed Systems


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 2 | 3 | | | | | | | | 3 | 2 | |
| CO2 | 2 | 3 | 3 | 3 | | | | | | | | 2 | 2 | |
| CO3 | 3 | 2 | 3 | 2 | | | | | | | | 3 | 3 | 2 |
| CO4 | 2 | 3 | 3 | 2 | | | | | | | | 3 | 2 | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP2020 | Big Data and Analytics using R | 16 | HC | 4 | 0 | 1 | 5 | 6 |

**Pre-requisites**

Probability and Statistics, Programming Language (C/C++/Java), Database Management Systems and Introduction to Data mining.

**Course Objectives**

The objectives of this course are to:

1. Understand the fundamentals of 'R' programming.
2. Explore few statistical methods that can apply for data manipulation and Importing techniques.
3. Discuss different Regression techniques.
4. Illustrate the working of clustering algorithms using R.

**Course Outcomes**

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

1. Explain the fundamentals of R Programming Language.
2. Apply and compare basic machine learning techniques using R for data analytics.
3. Design and Implement algorithms to learn Regression techniques for data analysis.
4. Perform analytics and build models for real world data science problems.

**Course Contents**

**Unit - 1**
A brief introduction to R: An overview of R, Vectors, factors, and univariate time series, Data frames and matrices, Functions, operators, and loops. Styles of data analysis: Revealing views of the data, Data summary, Statistical analysis questions, aims, and strategies.

**Unit - 2**
Statistical models: Statistical models, Distributions; models for the random component, Simulation of random numbers and random samples. A review of inference concepts: Basic concepts of estimation, Confidence intervals and tests of hypotheses, Contingency tables, Re-sampling methods for standard errors, tests, and confidence intervals, Theories of inference.

**Unit - 3**
Regression with a single predictor: Fitting a line to data, Outliers, influence, and robust regression, Standard errors, and confidence intervals, Assessing predictive accuracy. Multiple linear regression; Basic ideas: a book Weight example, the interpretation of model coefficients, multiple regression assumptions, diagnostics, and efficacy measures, A strategy for fitting multiple regression models.

**Unit - 4**

Logistic Regression: Building a Linear Model for Binary Response Data, Interpretation of the Regression Coefficients in a Logistic Regression Model, Statistical Inference, Classification of New Cases, Estimation in R. Binary Classification, Probabilities, and Evaluating Classification Performance: Binary Classification, Using Probabilities to Make Decisions, Sensitivity and Specificity, Example: German Credit Data, Clustering: k-Means Clustering, Another Way to Look at Clustering: Applying the Expectation-Maximization (EM) Algorithm to Mixtures of Normal Distributions, Hierarchical Clustering Procedures.

**Lab Experiments:**

1. a. Vectors are the most basic R data objects and there are six types of atomic vectors. They are double, complex, character and raw. Write a program in R to demonstrate the use of Vector objects.
   b. Factors are the data objects which are used to categorize the data and store it as levels. They can store both strings and integers. They are useful in the columns which have a limited number of unique values. Like "Male, "Female" and True, False etc. They are useful in data analysis for statistical modelling Write a program in R to demonstrate the use of Factor Objects.
   c . A data frame is a table or a two dimensional array like structure in which each column contains values of one variable and each row contains one set of values from each column.
   Following are the characteristics of a data frame.
   - The column names should be non-empty.
   - The row names should be unique.
   - The data stored in a data frame can be of numeric, factor or character type.
   - Each column should contain same number of data items.

   Write a program in R to demonstrate the use of Data frame Objects
   d. Matrices are the R objects in which the elements are arranged in a two dimensional rectangular layout. They contain elements of the same atomic types. Though we can create a matrix containing only characters or only logical values, they are not of much use. We use matrices ontaining numeric elements to be used in mathematical calculations.

2. Write a program in R to demonstrate the use of Data frame Objects

3. Write a program in R which performs addition, subtraction, multiplication and division of two vectors.

4. Create a Comma Separated Values file consisting of the following details: Employee ID, Employee Name, Employee Phone Number, Address, Salary Display the input as Data Frames and also print the maximum salary within the input CSV.

5. Predict weight of a person with the person's height known using a linear regression. Use lm() to create a relationship model. Also, find the coefficients from the model created. Get a summary of the relationship model to obtain the average error in prediction.

6. Create a dataset "mtcars" available in the R environment. It gives a comparison between different car models in terms of mileage per gallon (mpg), cylinder, displacement ("disp"), horse power ("hp"), weight of the car("wt") and some more parameters. Create a regression equation to predict the mileage of a car given the disp, hp and wt.

7. Consider the annual rainfall details at a place starting from January 2012. Create an R time series object for a period of 12 months and plot it. Further, plot multiple time series within a single graph.

8. Use the R in-built data set named readingSkills to create a decision tree. It describes the score of someone's readingSkills if we know the variables "age", "shoesize", "score" and whether the person is a native speaker or not. Create a decision tree to show which age group and shoesize group is considered as a native speaker?

9. Use the same dataset readingSkills as above mentioned and identify what categorizes as a native speaker using Random Forests by creating 500 trees.

10. The iris dataset contains data about sepal length, sepal width, petal length, and petal width of flowers of different species. Knowing that there are a total of three species of flowers, perform k – Means clustering with value of "k" as 3 in order to create three clusters.

**Recommended Learning Resources**


1. John Maindonald, W. John Braun, "Data Analysis and Graphics Using R – an Example Based Approach", 3rd Edition, Cambridge University Press, 2010. (Chapters 1.1 – 1.4, 2.1 -2.3, 3.1 - 3.3, 4.1 -4.3, 5.1 – 5.4, 6.1 -6.4)
2. Johannes Ledolter, "DATA MINING AND BUSINESS ANALYTICS WITH R", WILEY, 2013. (Chapters 7, 8 and 15)
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", Notes on R: A Programming Environment for Data Analysis and Graphics Version 3.2.4 (2016-03-10)
4. Roger D. Peng, "R Programming for Data Science", Leanpub, 2015
5. Springer, International Journal of Data Science and Analytics.
6. Elsevier, Computational Statistics & Data Analysis
7. IEEE, Transactions on Big Data.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | **3** | **2** | **2** |
| CO2 | 3 | 3 | 2 | 3 | 2 | | | | | | | **3** | **3** | **2** |
| CO3 | 3 | 2 | 3 | 2 | 2 | | | | | | | **3** | **3** | **2** |
| CO4 | 2 | 3 | 3 | 2 | 2 | | | | | | | **3** | **2** | **2** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./ WK. |
|---|---|---|---|---|---|---|---|---|
| M18CSP2030 | Internet Of Things | 16 | HC | 4 | 1 | 0 | 5 | 6 |

**Prerequisite:**

Programming knowledge in C Language; Basic knowledge of Electronics and Logic Design

**Course Objectives**

The objectives of this course are to:

1. Provide knowledge about the basics of embedded systems and embedded system design
2. Describe Internet-of-Things and design principles
3. Explain the ease of prototyping and production, and think of deployment for the community.
4. Give knowledge about internet principles and techniques for writing embedded code

**Course Outcomes**

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

1. Understand the basic concept of IoT, protocols and different IoT levels for deployment
2. Differentiate between M2M and IoT communication and will be able to understand steps involve IoT design Methodology and basic programming with python.
3. Understand the Raspberry Pi architecture, upload the code on the board and will be able to communicate to Cloud
4. Perform data analytics using different analytics platforms and understand ethics behind the IoT Development

**Course Contents**

**Unit-I**

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

**Unit-II**

**IoT and M2M**: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT

**Platform Design Methodology,** Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System

**Unit-III**

**Logical Design Using Python**, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.

IoT Physical Devices and End Points: What is and IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces, programming raspberry pi with python, other IoT devices.

**Unit-IV**

**Case Study & advanced IoT Applications:** IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards

**Recommended Learning Resources**


1. Internet of Things, A Hands on Approach, by Arshdeep Bahga & Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson
3. Adrian McEwen & Hakim Cassimally: Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication.
4. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 3 | 3 | | | | | | | **1** | **2** | **3** |
| CO2 | 2 | 1 | 3 | 3 | 2 | | | | | | | **1** | **3** | **3** |
| CO3 | 3 | 2 | 2 | 3 | 3 | | | | | | | **2** | **3** | **1** |
| CO4 | 3 | 2 | 2 | 3 | 2 | | | | | | | **3** | **1** | **3** |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4011 | **Computer Network Engineering** | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Course Objectives:**

The objectives of this course are to:

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

**Course Outcomes:**

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

1. Demonstrate the basic computer network technology;
2. Understand and explain Layered architecture;
3. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer;
4. Implement scheduling algorithms to provide end-to-end Quality of sevice;

**Course Contents:**

**Unit- 1**
**Network Services and Layered Architectures:** Applications; Traffic Characterization and Quality of Service; Network Services; High-Performance Networks; Network Elements; Basic Network Mechanisms; Layered Architecture; Open Data Network Model; Network Architectures; Network Bottlenecks.

**Unit- 2**
**The Internet and TCP/IP Networks:** Internet, Overview of Internet Protocols, Internet Protocol, TCP and UDP, Internet Success and Limitation, Performance of TCP/IP Networks

**Unit- 3**
**Scheduling:** Introduction; Requirements; Fundamental Choices; Scheduling best-effort connections; scheduling guaranteed-service connections.
**Flow Control:** model; classification; open-loop flow control; closed-loop flow control; Hybrid flow control

**Unit- 4**
**Traffic Management:** Introduction ;An economic framework for Traffic management; Traffic models; Traffic classes; Time scales of traffic management ; Renegotiation; Signaling; Admission Control ; Peak-load pricing, capacity planning.

**Recommended Learning Resources:**.


1. S. Keshav, an Engineering Approach to Computer Networking, Pearson Education.
2. Jean Walrand & pravinVaraiya, High performance communication networks, 2nd Edition, Elsevier publishing
3. Andrew S. Tanenbaum, Computer Networks, Fourth Edition, Prentice Hall.
4. ACM Transactions on Networking
5. IEEE Transactions on Networking
6. ACM Transactions on Computer Systems


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 3 | 2 | 2 | | | | | | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 3 | | | | | | 3 | 2 | 2 |
| CO3 | 3 | 2 | 2 | 3 | 3 | 2 | | | | | | 3 | 2 | 3 |
| CO4 | 2 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 2 |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4012 | Research Methodology | **16** | **SC** | **4** | **1** | **0** | **5** | **6** |

**Course Objectives:**

The objectives of this course are to:

1. Familiarize the student with the dimensions and methods of research.
2. Orient the student to make an informed choice from the large number of alternative methods and experimental designs available
3. Enable the student to present a good research proposal.
4. Familiarize the student with the nature of research and scientific writing
5. Empower the student with the knowledge and skills they need to undertake a research project, to present a conference paper and to write a scientific article.

**Course Outcomes:**

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

1. Appraise some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)

**Unit -1:**

**Research Methodology**: An Introduction - meaning of research - objectives of research - motivation in research - types of research - research approaches - significance of research -research methods versus methodology - research and scientific method - importance of knowing how research is done - research processes - criteria of good research

**Defining research problem:** selecting the problem - necessity of defining the problem - techniques involved in defining a problem.

**Unit - 2:**

**Research design:** meaning of research design - need for research design - features of good design - different research designs - basic principles of experimental design. (Kothari)

**Originality in Research**- research skills - time management - role of supervisor and scholar - interaction with subject experts.

**Review of Literature** Description: Review of Literature: Significance of review of literature - source for literature: books -journals – proceedings - thesis and dissertations - unpublished items. On-line Searching: Database – SciFinder – Scopus - Science Direct - Searching research articles - Citation Index - Impact Factor - H-index etc, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

**Thesis Writing**: The preliminary pages and the introduction - the literature review - methodology - the data analysis - the conclusions - the references (in IEEE and ACM format).

**Unit – 3:**

**Data Collection and Preparation:** Sample surveys, sampling errors, types of sampling designs, experiment and surveys, collection of primary data and secondary data, methods, data preparation process, outliers, analysis, statistics.
**Descriptive Statistics:** measures of central tendency, dispersion, skewness, relationship, kurtosis, sampling distribution, central limit theorem, statistical inference
**Introduction toTools used in Computer Science**: MATLAB, NS2/3, C, C++, Java, Web Service, SPSS, SAS, LOTUS, Excel, Latex and Ms Word.
**Unit – 4:**
**Testing hypothesis:** Concepts, testing, critical region, decision, hypothesis testing for mean proportion and variance, limitations, chisquare test, oneway ANOVA.

**Linear Regression Analysis:** Simple model,multiple model and T-test.

**LaTeX and Beamer** Description: Writing scientific report - structure and components of research report - revision and refining' - writing project proposal - paper writing for international journals, submitting to editors - conference presentation - preparation of effective slides, pictures, graphs - citation styles. Software for detection of Plagiarism. IPR and Patent filing.
**Note**: Every batch of students comprising maximum of 4 members should define a research problem. Develop solution for the problem. Write a technical paper and publish it in IEEE/reputed conference/journal.

**Recommended Learning Resources:**


1. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
2. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
3. P. Oliver, Writing Your Thesis,New Delhi:Vistaar Publications, 2004.
4. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004.
5. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3nd. ed. Sage Publications, 2008.
6. Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd. ed. Indian: PE, 2005.
7. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis,2nd. ed. New Delhi: TMH publishing Co. Ltd., 2005.
8. I. Gregory, Ethics in Research, Continuum, 2005.
9. COLIN NEVILLI , " The complete guide to referencing and avoiding plagiarism" , Second Edition published by Open Up Study Skills.
10. **RUDRA PRATAP** , " Getting Started with MATLAB " , published by Oxford University Press-2010
11. **TEERAWAT, ISSARIYAKUL, EKRAM, HOSSAIN – 2008 , "Introduction to Network Simulator NS2"**
12. https://www.stir.ac.uk/media/services/registry/quality/**Book**of**Plagiarism**.pdf
13. ceur-ws.org/Vol-706/poster22.pdf

**14.** https://**books**.google.co.in/**books**?isbn=1446281094

**15.** www.nalsarpro.org/pl/projects/modelproject2.pdf

**16.** www.uninova.pt/cam/teaching/SRMT/SRMTunit11.pdf

**17.** http://matlab_tools.myetang.com/index_e.htm

Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | **2** | **1** | **1** | **3** | **1** | **1** | **2** | **1** | **1** | **1** | **1** | **2** | **2** | **2** |
| CO2 | **3** | **3** | **3** | **3** | **2** | **1** | **3** | **1** | **1** | **1** | **1** | **3** | **2** | **2** |
| CO3 | **3** | **3** | **3** | **3** | **3** | **1** | **3** | **3** | **1** | **1** | **1** | **3** | **2** | **2** |
| CO4 | **3** | **3** | **3** | **3** | **3** | **1** | **3** | **3** | **1** | **1** | **1** | **2** | **2** | **2** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CS2043 | Open Source Cloud Computing Tools | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Prerequisites:**

Computer Networks, Operating System

**Course Objectives:**

The objective of this course is to:

1. Design and develop the various programming model and applications on private cloud environment.
2. Encourage usage of open source software designed to deploy and manage large networks of virtual machines, as a highly available, highly scalable Infrastructure as a Service (IaaS) cloud computing platform.
3. Understand Usage of Cloud Stack, which is used by a number of service providers to offer public cloud services, and by many companies to provide an on-premises (private) cloud offering, or as part of a hybrid cloud solution.
4. Techniques to manage cloud with an easy to use Web interface, command line tools, and/or a full-featured RESTful API.

**Course Outcomes:**

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

1. Understand different virtualization technique through theoretical concepts and practical training
2. Understand the practical implementation of map reduce application developments on cloud based hadoop framework
3. Become knowledgeable and expertise in cloud application development process
4. Develop and deploy applications on private cloud environment like Eucalyptus and Openneubla

**Course Contents:**

**Unit – 1**

**INTRODUCTION TO CLOUD COMPUTING AND RESOURCE VIRTUALIZATION**

Cloud Computing delivery models and services, Introduction to Virtualization, Layering and virtualization, Virtual machine monitors, Virtual machines, Performance and Security Isolation, Full virtualization and para virtualization, Hardware support for virtualization, Case study: Xen, a VMM based on para virtualization

**Unit – 2**

**CLOUD BASED APPLICATION DEVELOPMENT**

Amazon Web Services: EC2 instances, Connecting clients to cloud instances through firewalls, Application and transport layer protocols in EC2, Launch and connect EC2 Linux instance, Use S3 in Java, Install Simple Notification Service on Ubuntu, Create EC2 Placement Group and use MPI.

**Unit – 3**

**OPENNEBULA-A CLOUD ON VMWARE VCENTER**

Overview of Components and Accounts, Simple Cloud Deployment, Download and Deploy vOne Cloud, Import Existing vCenter, Create a Virtual Data Center, Interfaces, Security and Resource Consumption Control, Guest Configuration, Infrastructure Configuration, Appliance Configuration.

**Unit – 4**

**EUCALYPTUS OPEN-SOURCE PRIVATE CLOUD**

Introduction to Eucalyptus, Eucalyptus Overview, Eucalyptus Components, System Requirements, Eucalyptus Installation, Eucalyptus Network Migration and Upgrade, Eucalyptus Upgrade, Euca2ools Standalone Installation, Overview of Euca2ools, Installing Euca2ools, Configuring Euca2ools, EC2 Compatible Commands.

**Recommended Learning Resources:**

REFERENCES


1. Dan C. Marinescu, "Cloud Computing - Theory and Practice", 1st Edition, Morgan Kaufmann is an imprint of Elsevier, 2013, ISBN :9780124046276.
2. BirisLublinsky, Kevin T. Smith and Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN 13:9788126551071, 2015.
3. The Open Replacement for vCloud - Bring your VMware environment to the Cloud in 5 minutes. http://vonecloud.today/ ,http://docs.vonecloud.com/1.8/
4. Eucalyptus 3.4.2 FastStart Guide. http://docs.hpcloud.com/pdf/static/Eucalyptus_3.4/faststart-guide-3.4.2.pdf
5. Cloud services for your virtual infrastructure, Part 1: Infrastructure-as-a-Service (IaaS) and Eucalyptus. http://www.ibm.com/developerworks/library/os-cloud-virtual1/
6. YohanWadia, "The Eucalyptus Open-Source Private Cloud". Last Accessed on: http://www.cloudbook.net/resources/stories/the-eucalyptus-open-source-privatecloud as on
7. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN-13: 978-0996025508.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 3 | | | | | 1 | 1 | 1 | **3** | **3** | **3** |
| CO2 | 3 | 2 | 3 | 3 | | | | | 1 | 1 | 1 | **3** | **3** | **3** |
| CO3 | 3 | 2 | 3 | 3 | | | | | 1 | 1 | 1 | **3** | **3** | **3** |
| CO4 | 3 | 2 | 3 | 3 | | | | | 1 | 1 | 1 | **3** | **3** | **3** |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CS2051 | Unix Operating System and Internals | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Prerequisites:**

Computer Concepts and C Programming, Computer Organization

**Course Objectives:**

The objectives of this course are to:

1. Introduce the history ,basics and structure of Operating System
2. Describe process concepts and scheduling techniques
3. Familiarize with physical and virtual memory management techniques
4. Describe UNIX kernel, data structures and internal representation of files in UNIX operating system

**Course Outcomes:**

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

1. Explain the history, basics and structure of operating systems
2. Implement various process management and scheduling schemes
3. Design and develop memory management techniques
4. Demonstrate the internals of UNIX operating system

**Course Contents:**

**Unit – I:**

**Operating System Principles:** Evolution of Operating Systems, Structural overview, Types of Operating System and operations, Computing environments, Operating System Services, User - Operating System interface, System calls and system programs, Operating System structure, Virtual machines.

**Unit – II:**

**Process Management:** Process concept, process scheduling, Operations on processes, Inter process communication. Multi-Threaded Programming, Overview, Multithreading models, Thread Libraries, threading issues. Process scheduling: Basic concepts, scheduling criteria, Scheduling algorithms, Multiple Processor scheduling Thread scheduling.

**Unit – III:**

**Memory Management:** Memory Management Strategies, Swapping, contiguous memory allocation, Paging, structure of page table, Segmentation. Virtual Memory Management: Background, Demand paging, copy-on-write, Page replacement, Allocation methods, Thrashing.

**Unit – IV:**

**UNIX kernel and its files:** Introduction to Kernel: Architecture of the UNIX operating system, Introduction to system concepts, Kernel data structures, System Administration, Internal representation of Files: Inodes, structure of a regular file, Directories, Conversion of a path Name to an Inode, Super block, Inode assignment to a new file, Allocation of disk blocks, other file types.

**Recommended Learning Resources:**


1. Abraham Silberschatz, Peter BearGalvin, Greg Gagne ,Operating System Principles, Wiley Asia Student Edition 2009.
2. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition 2011.
3. Maurice J. Bach ; The Design of the UNIX Operating System; Pearson Education; Prentice Hall of India, 2004.
4. 1.D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill,2002.

*1.* Charles Crowley; Operating System: A Design-oriented Approach; Irwin Publishing,2002.

*2.* Gary J. Nutt; Operating Systems: A Modern Perspective; Addison-Wesley, 2011.

*3.* Springer Transaction for advance in Distributed computing and middleware.

*4.* IEEE Transaction for Real time operating system.

*5.* ACM Transaction for embedded operating system.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 2 | 2 | 2 | 3 | | | | | | 3 | 2 | 2 |
| CO2 | 2 | 2 | 2 | 3 | 3 | 3 | | | | | | 2 | 2 | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | 3 | | | | | | 3 | 2 | |
| CO4 | 2 | 3 | 3 | 2 | 2 | 3 | | | | | | | 2 | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./ Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4022 | Cyber Security | 16 | SC | 4 | 1 | 0 | 5 | 6 |

**Pre-requisites:**

Computer networking

**Course Objectives:**
The objectives of this course are to:

1. Introduce the concepts of computer network security covering security architecture and services.
2. Describe security encryption algorithms and standards such as DES.
3. Provide the knowledge about Public key Cryptographic Principles and Algorithms.
4. Explain the features of network security applications

**Course Outcomes:**
On successful completion of this course; student shall be able to:

1. Explain the concepts of computer network security covering security architecture and services.
2. Use security encryption algorithms and standards such as DES for developing applications
3. Implement Public key Cryptographic Algorithms and integrate them with secured data transaction based systems.
4. Demonstrate the features of network security applications

**Course Contents:**

**UNIT – I:**
**Introduction:** The OSI Security Architecture, Security Attacks, Security Services, mechanisms, A model for network security, standards, symmetric encryption principles, Symmetric Block Encryption Algorithms, Data Encryption Standards, Strength of DES, Triple DES, Advanced Encryption Standard.

**UNIT – II:**
**Public-Key Cryptography and Message Authentication:** Public key Cryptographic Principles, Public Key Cryptographic Algorithms (RSA, Diffie-Hellman), Approaches to Message Authentication, Secure Hash Functions (SHA-512), Message Authentication Codes, Digital Signatures.

**UNIT – III:**
**Network Security Applications:** X.509 Certificate Format, Overview of Kerberos (Key Exchange), PGP- Features of PGP, Key Rings in PGP, S/MIME, IPSec Overview, Intrusion Detection.

**UNIT – IV:**
**Electronic Mail Security:** Password Management, Virus and threats, Virus Countermeasures, Firewalls, The Need for Firewalls, Firewall Characteristics, Types of Firewalls. 77

**Recommended Learning Resources:**


1. William Stallings, Network Security Essentials Applications and Standards, Fifth edition, Prentice Hall, 2011
2. Behrouz A. Forouzan, Cryptography and Network Security, Mc Graw Hill,2007.
3. William Stallings, Cryptography and Network Security Principles and Practise, Pearson, Sixth edition, 2013
4. Joseph Migga Kizza, Guide to Computer Security, Springer Science & Media Inc., Third edition, 2015
5. Andrew S. Tanenbaum, Computer Networks, Pearson, Fifth edition.
6. Atul Kahate, Cryptography and Network Security, Mc-Graw Hill, 2013.
7. Springer Journal of Cryptographic Engineering , ISSN 2190-8508
8. ACM,ACM- International Journal of Applied Cryptography,ISSN:1753-0563
9. IEEE, IEEE Transactions on Information Forensics and Security.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 3 | 3 | | | | | | | **3** | **3** | **1** |
| CO2 | 3 | 2 | 3 | 3 | 2 | | | | | | | **3** | **3** | **2** |
| CO3 | 3 | 3 | 2 | 3 | 3 | | | | | | | **3** | **3** | **2** |
| CO4 | 3 | 3 | 3 | 3 | 2 | | | | | | | **3** | **3** | **1** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4023 | **Advanced Java Programming** | **16** | **SC** | **4** | **1** | **0** | **5** | 6 |

**Prerequisites:**

Computer Programming Skills and Applications; Data Structures and Algorithms

**Course Objectives:**

The objectives of this course are to:

1. Describe Java language syntax and semantics required for understanding Java programs (applets and applications)
2. Illustrate the usage of a Java-enabled browser and/or the appletviewer to execute Java applets along with Java Application Programming Interface and Java multi-class programs
3. Design, implement, test, and debug Java applications written using basic concepts such as primitive data types, various operators, control structures, single-subscripted arrays, and Java classes
4. Explain the Java applications written using applets and object-based programming techniques including classes, objects and inheritance

**Course Outcomes:**

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

1. Analyze the principles and concepts of object-oriented programming;
2. Use a Java-enabled browser and/or the applet viewer to execute Java applets
3. Use the Java interpreter to run Java applications
4. Apply object oriented concepts; such as inheritance; polymorphism; abstract classes and interfaces; and packages in program design.

**Course Contents:**

**UNIT – I:**

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

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

**UNIT – II:**

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

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

**UNIT – III:**

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

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

**UNIT – IV:**

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

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

**Recommended Learning Resources:**


1. Barry J. Holmes and Daniel T. Joyce, Object-Oriented Programming With Java; Second Edition; Jones And Bartlett Publishers,2000
2. Dale Skrien; Object-Oriented Design Using Java; McGraw-Hill Higher Education; 2009
3. Danny Poo; Object-Oriented Programming and Java; Second Edition; Springer; 2008.
4. Cay Horstmann; Big Java; 2nd Edition ; John Wiley and Sons
5. Herbert Schildt; The Complete Reference Java J2SE; 5th Edition; TMH Publishing Company Ltd, New Delhi
6. H.M. Dietel and P.J. Dietel; Java How to Program; Sixth Edition; Pearson Education/PHI
7. Cay.S. Horstmann and Gary Cornell; Core Java 2, Vol 1, Fundamentals; Seventh Edition; Pearson Education/PHI
8. Cay.S. Horstmann and Gary Cornell; Core Java 2, Vol 2, Advanced Features; Seventh Edition; Pearson Education/PHI
9. Beginning in Java 2 by Iver Horton, Wrox Publications.


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 3 | 1 | | | | | | **2** | **3** | **2** | **2** |
| CO2 | 3 | 3 | 3 | 2 | 1 | | | | | | **1** | **3** | **1** | **1** |
| CO3 | 3 | 3 | 3 | 2 | 1 | | | | | | **1** | **2** | **2** | **2** |
| CO4 | 3 | 3 | 3 | 2 | 1 | | | | | | **2** | **3** | **3** | **1** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4031 | **Parallel Computing and Programming** | **16** | **SC** | **4** | **1** | **0** | **5** | 6 |

**Prerequisites:**

Students must have studied Data Structures , Operating Systems and C/ C++ programming language.

**Objectives:**

The objectives of the course are to:

**1)** Introduce the basic theory underlying parallel computing.

**2)** Learn different algorithms for parallel programming

**3)** Implement Parallel algorithms using OPENMP.

**Course Outcomes:**

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

1) Recognize about task and data parallel programs.

2) Express common algorithms in a functional style and solve them in parallel.

3) Develop programs that effectively use parallel collections to achieve performance

4) Analysis the program using various Modelling.

**Course Contents:**

**Unit-1:** Introduction to parallel computing: Motivating Parallelism, Scope of parallel computing, Parallel Programming Platforms: Implicit parallelism, Limitations of Memory systems performance, Physical organization of parallel platforms, Communications costs in parallel Machines, Routing Mechanisms for interconnection networks, impact of process-processor Mapping and Mapping Techniques.

**Unit-2:** Principles parallel algorithm design, preliminaries, decomposition techniques characteristics of tasks and interactions, mapping techniques load balancing, parallel algorithm models

**Unit-3:** Analytical modelling of parallel programs: sources of overhead in parallel programs, performance Metrix for parallel system, the effect of granularity on performance, programming using message passing paradigm

**Unit-4:** Programming shared address space platforms, Thread basics, why thread, the POSIX thread API, thread creation and termination, synchronization primitives in Pthreads, controlling threads and synchronization attributes, thread cancellation, composite synchronization constructs, openMP

**Recommended Learning Resources:**

1. Introduction to Parallel Computing by Ananth Grama, George Karypis, Vipin Kumar,

and Anshul Gupta.

2. Parallel programming in C with MPI and OPENMP

Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 3 | 3 | 3 | **1** | **1** | **1** | **1** | **1** | **1** | **3** | **3** | **2** |
| CO2 | 3 | 3 | 3 | 2 | 2 | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **2** | **3** |
| CO3 | 3 | 3 | 3 | 3 | 3 | **1** | **1** | **1** | **1** | **1** | **1** | **3** | **3** | **2** |
| CO4 | 3 | 3 | 2 | 3 | 3 | **1** | **1** | **1** | **1** | **1** | **1** | **3** | **2** | **3** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| **Course Code** | **Course Title** | **Duration (Weeks)** | **Course Type** | **L** | **T** | **P** | **C** | **Hrs. /Wk.** |
|---|---|---|---|---|---|---|---|---|
| **M18CS2062** | **Human Computer Interaction (UI/UX Design)** | **16** | **SC** | **4** | **1** | **0** | **5** | 6 |

**Course Objectives:**

The objectives of the course are to:

1. Describe basic theories, tools and techniques in HCI.
2. Explain the fundamental aspects of designing and evaluating interfaces.
3. Practice a variety of simple methods for evaluating the quality of a user interface.
4. Apply appropriate HCI techniques to design systems that are usable by people.

**Course Outcomes:**

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

1. Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.

**Course Contents:**

**Unit – I:**

**Introduction and the graphical user interface:** Importance of user Interface, definition, importance of good design, benefits of good design, a brief history of Screen design, popularity of

graphics, the concept of direct manipulation, graphical system, Characteristics, Web user Interface popularity, characteristics-Principles of user interface.

**Unit – II:**
**Design process:** Human interaction with computers, importance of human characteristics human consideration, human interaction speeds, understanding business junctions.

**Unit – III:**
**Screen Designing:** Design goals, screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, amount of information, focus and emphasis presentation, information simply and meaningfully, information retrieval on web, statistical graphics, technological consideration in interface design.

**Unit – IV:**
**Software tools and Interaction Devices:** Specification methods, interface, building tools, keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays, drivers.

**Recommended Learning Resources:**


1. Jenreece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, Wiley
2. Julie A. Jacko, Human Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications, Third Edition, CRC Press
3. M.G. Helander T.K. Landauer P.V. Prabhu, Handbook of Human-Computer Interaction, 2nd Edition, Elsevier
4. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 2 | 3 | 1 | 2 | | | | | | | | **3** | **2** | **-** |
| CO2 | 2 | 3 | 3 | 2 | 1 | | | | | | | **2** | **2** | **1** |
| CO3 | 2 | 1 | 2 | 2 | | | | | | | | **1** | **-** | **-** |
| CO4 | 2 | 2 | 2 | 3 | | | | | | | | **2** | **-** | **-** |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP4033 | **Embedded Computing Systems** | **16** | **SC** | **4** | **1** | **0** | **5** | 6 |

**Prerequisites:**

Microprocessors; Microcontrollers; Operating Systems; C programming

**Course Objectives:**

The objectives of this course are to:

1. Provide knowledge about the basics of embedded systems and embedded system design
2. Describe Internet-of-Things and design principles
3. Explain the ease of prototyping and production, and think of deployment for the community.
4. Gain expertise in integrating sensing, actuation and software

**Course Outcomes:**

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

1. Explain the basics of embedded systems and design embedded systems
2. Design and Develop Internet-of-Things based applications
3. Develop prototypes of Internet-of-Things based applications, and deploy for the usage of the community.
4. Integrate sensing, actuation and software

**Course Contents:**

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

**Unit – II:**
**The Internet of Things: An Overview & Design Principles:** The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things? Design Principles for Connected Devices, Calm and Ambient Technology, Magic as Metaphor, Privacy, Web Thinking for Connected Devices, Affordances.

**Unit – III:**
**Thinking About Prototyping and Prototyping Embedded Devices**: Sketching, Familiarity, Costs versus Ease of Prototyping, Prototypes and Production, Open Source versus Closed Source, Tapping into the Community, Electronics, Arduino, Raspberry Pi, Beagle Bone Black, Electric Imp, And other Notable Platforms.

**Unit – IV:**
**Internet Principles and Techniques for Writing Embedded Code:** Internet Communications, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols, Memory

Management, Performance and Battery Life, Libraries, Debugging, Current challenges in IoT. Recommended Learning Resources:


1. Wayne Wolf; Computers as Components: Principles of Embedded Computing System Design; second Edition; Elsevier; 2008.
2. Adrian McEwen, Hakim Cassimally; Designing the Internet of Things; Wiley; 2014.
3. *Kurose, James F.; Ross, Keith W:* **Computer networking: a top-down approach** 5th ed., international ed.: Boston, Mass.: Pearson, cop. 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi: The Internet of Things: Key Applications and Protocols; Wiley; 2015.
5. Frank Vahid, Tony Givargis: Embedded System Design: A Unified Hardware/Software Introduction; Wiley; 2006.
6. Springer, Design Automation for Embedded Systems
7. IEEE, IEEE Internet of Things Journal
8. Elsevier, Journal of Network and Computer Applications,
9. Elsevier, Computer Law & Security Review
10. ACM, ACM Transactions on Internet Technology (TOIT)


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 3 | 3 | 3 | 2 | | | | | | | 3 | 3 | 1 |
| CO2 | 3 | 3 | 3 | 3 | 3 | | | | | | | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 2 | 3 | | | | | | | 3 | 3 | 1 |
| CO4 | 3 | 3 | 3 | 3 | 2 | | | | | | | 3 | 2 | |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

**II Year Detailed Syllabus**

**Third Semester**

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs/Wk |
|---|---|---|---|---|---|---|---|---|
| M18CS3011 | Text & Web Mining | 16 | SC | 3 | 1 | 0 | 4 | 5 |

**Prerequisites:**

Basic Knowledge of Data Structures and Statistics;,Data Mining Concepts;Basic Understanding of HTML Coding;Basic Programming Knowledge;

**Course Objectives:**

The objectives of this course are to:

1. Explain the basic concepts of Web Data Mining such as Text Pre-Processing, Information Retrieval

Models and Performance Evaluation Measures

2. Illustrate the application of Web Crawling and Structured Data Extraction;

3. Discuss the knowledge about the concepts of Web Usage and Query Log Mining;

4. Demonstrate the concepts of Sentiment Analysis for real world problems.

**Course Outcomes:**

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

CO1. Make use of the process of Web Mining for formation Retrieval and Text Pre-Processing.

CO2. Develop Web Crawling such as Search Engines, Structured Data Extraction for Web Data Mining.

CO3. Choose the advanced concepts in Web Usage and Query Log Mining in real world problem.

CO4. Apply Sentiment Analysis to classifiy the real web data.

**Course Contents:**

**Unit1 : Web Mining – Information Retrieval and Web Search**
Introduction: What is World Wide Web? , Web Data Mining: What is Data Mining? What is Web Mining?, Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval. Model: Boolean Model, Information Retrieval Model: Vector Space Model, Evaluation Measures, Text and Web Page Pre-Processing: Stop Words, Stemming, Other Pre-Processing Tasks, Text and Web Page. Pre-Processing: Web Page Pre-Processing, Duplicate Detection Web Search

**Unit 2: Web Crawling and Data Extraction**

Web Crawling – A Basic Crawler Algorithm, Implementation Issues: Fetching, Parsing, Implementation Issues: Stopword Removal and Stemming, Link Extraction and Canonicalization, Spider Traps, Implementation Issues: Page Repository, Concurrency, Crawler Ethics and Conflicts

Some New Developments: Structured Data Extraction: Wrapper Generation – Introduction, Building DOM Trees, Extraction Based on a Single List Page: Flat Data Records – Two Observations About Data Records, Extraction Based on Multiple Pages – Road Runner Algorithm, SAX Parser – Introduction

**Unit 3 – Web Usage Mining**

Web Usage Mining – Introduction: Data Collection and Pre-Processing, Sources and Types of Data, Key Elements of Web Usage Data Pre-Processing

Data Modeling for Web Usage Mining, Query Log Mining – Introduction, Data Sources, Characteristics and Challenges, Query Log Mining – Query Log Data Preparation, Query Log Mining – Query Log Data Models, Query Log Mining – Query Log Feature Extraction, Applications

**Unit 4 – Sentiment Analysis**

Sentiment Analysis – Introduction: The Problems of Opinion Mining, Aspect Based Opinion Summary, Document Sentiment Classification – Classification Based on Supervised Learning, Document Sentiment Classification – Classification Based on Unsupervised Learning, Sentence Subjectivity and Sentiment Classification

Opinion Lexicon Expansion, Aspect Based Opinion Mining – Aspect Sentiment Classifications, Aspect Based Opinion Mining – Basic Rules of Opinions, Aspect Based Opinion Mining – Aspect Extraction, Opinion Search and Retrieval

Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 1 | 2 | 2 | 2 | - | - | - | - | - | - | 3 | 3 | 3 |
| CO2 | 2 | 3 | 1 | 2 | 1 | - | - | - | - | - | - | 3 | 3 | 2 |
| CO3 | 2 | 1 | 1 | 2 | 1 | - | - | - | - | - | - | 3 | 3 | 2 |
| CO4 | 2 | 2 | 1 | 3 | 2 | - | - | - | - | - | - | 3 | 3 | 2 |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs. /Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP5012 | **Soft Computing** | **16** | **SC** | **3** | **1** | **0** | **4** | 5 |

**Prerequisite:**

Linear algebra, calculus and statistics, as well as programming and some machine learning

**Course Objectives:**

The objectives of this course are to:

1. Examine the foundations of machine learning and neural networks
2. Illustrate the feasibility of applying a soft computing methodology for solving problems with computational intelligence.
3. apply fuzzy logic to handle uncertainty in engineering problems, genetic algorithms to combinatorial optimization problems, neural networks to pattern classification and regression problems.
4. evaluate and compare solutions with various soft computing approaches for a given problem.

**Course Outcomes:**

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

1. Understand the theory of neural networks and fuzzy logic systems with different types of learning
2. Identify a possible neuro-fuzzy technique to solve a given task
3. Evaluate the use of these techniques in a research publication Understand Neural Network Concepts and its architecture
4. Implement a simplified algorithm by applying a soft computing methodology for solving problems with computational intelligence

**Course Contents:**

**Unit 1:**

**Introduction to Soft Computing:** Historical Development, Definitions, advantages and disadvantages, solution of complex real life problems

89

**Fuzzy Systems:** Fuzzy sets (operations, membership functions), fuzzy relations, fuzzy reasoning (inference, algorithms, implication), fuzzy rule-based computing, fuzzy control (structure of fuzzy controllers, fuzzification, defuzzification, types of fuzzy controllers).

**Unit 2:**

**Neural Networks:** basics of the Neural Network, Training Feed-Forward Neural Networks , Beyond Gradient Descent, Convolutional Neural Networks:

**Unit 3:**

**Deep Learning:** Embedding and Representation Learning, Models for Sequence Analysis, Deep Reinforcement Learning

**Unit 4:**

**Evolutionary Computing:** Evolution in natural and artificial systems, search and optimization, problem representation, Genetic algorithms (selection, genetic operations), other evolutionary methods (Learning classifier systems, Artificial immune systems).

Hybrid Systems: Combining neural networks, fuzzy systems, and evolutionary computing

**Recommended Learning Resources:**


1. Sinha, N.K. and Gupta, M. M. : "Soft Computing and Intelligent Systems - Theory and Applications", Academic Press.
2. Buduma, Nikhil, and Nicholas Locascio. *Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms*. " O'Reilly Media, Inc.", 2017.
3. S.N. Sivanandan and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007. ISBN: 10: 81-265-1075-7.
4. Jang, J-S. R., Sun,C-T, Mizutani, E.: "Neuro–Fuzzy and Soft Computing", Prentice Hall of India.
5. Klir, G. J. and Yuan, B.: "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Prentice Hall.
6. Tettamanzi, A., Tomassini, M. "Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems", Springer.
7. Journal on Advances in Abstract Intelligence and Soft Computing
8. Journal of Soft Computing Applications and Intelligent Systems


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 1 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | **1** | 2 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 2 | **1** | **1** | **1** |
| CO4 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | **1** | **1** | 2 | 2 |

Where,1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO, PO and PSO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs./ Wk. |
|---|---|---|---|---|---|---|---|---|
| M18CSP5013 | **Wireless Networks** | **16** | **SC** | **3** | **1** | **0** | **4** | **5** |

**Prerequisites:**

Knowledge in Computer Networks

**Course Objectives:**

The objectives of this course are to:

1. Recall the growth of mobile communication under different generation

2. Outline the Wireless migration options

3. Illustrate Wireless Sensor Networks applications and various operating systems used.

4. Demonstrate the Advanced Broadband Wireless Access Technologies

**Course Outcomes**

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

1. Analyze the generation of mobile communication techniques
2. Compare the wireless migration options
3. Choose the suitable OS for a particular WSN application
4. Distinguish the various broadband wireless access technologies

**Course Contents**

**Unit-I: Introduction**

Amazing growth of Mobile Communications – History of First, Second, Third Generation systems, 4G and Beyond, Next Generation Wireless, Basic Network Architecture, Air-Interface Access Technologies, Roaming, Handoff/ Handover, Mobile data, Wi-Fi, Bluetooth, Cable Systems, Wireless Migration

Options, Network Structure, Packet data transport process flow, Simple IP with VPN, Mobile IP with VPN Traffic Forecasts, Build Ahead, Network Dimensioning, Interface design and Transmission Network Considerations, Placement of Nodes and Overall Network Topology

**Unit – II: Wireless Sensor Networks**

WSN Applications, Sensor and Robots, Reconfigurable Sensor Networks, Wireless Sensor Technology, Introduction to Sensor Node Technology, Overview, Hardware and Software, Sensor Taxonomy, WN Operating Environment, WN Trends, Middleware for Wireless Sensor Networks, WSN Middleware

Principles, Middleware Architecture, Data-Related Functions, Architectures, Existing Middleware, MiLAN (Middleware Linking Applications and Networks), IrisNet (Internet-Scale Resource-Intensive Sensor Networks Services), AMF (Adaptive Middleware Framework), DSWare (Data Service Middleware), CLMF (Cluster-Based Lightweight Middleware Framework), MSM (Middleware Service for Monitoring), Em*, Impala, DFuse, Operating Systems for Wireless Sensor Networks, Operating System Design Issues, Examples of Operating Systems, TinyOS, Mate, MagnetOS, SenOS, PicOS

**Unit – IV: Vehicular Adhoc Networks**

Motivation and History of VANETs, Message sets for Vehicular Communications, Cooperative ITS Technologies, DSRC Vehicular Communication Systems, Decentralized congestion control techniques for VANETs, Mobility model for Vehicular Communication, Macroscopic, Mesoscopic and Microscopic, Simulation Tools and Techniques for Vehicular Communications and Applications: Veins, iTETRIS and VSimRTI.

**Unit – III: 5G and Beyond**

Technology Path, Smart phones and Wireless Broadband Edge Devices (WBED), Software Defined Radio (SDR), Advanced Broadband Wireless Access, Ultra wideband (UWB), Unlicensed Wireless Access (UWA), FOMA and iMODE, WiBRO, FWA, Multimedia (Mobile TV), MediaFLO, T-DMB, DVB-H Digital, MVNO

**Recommended Learning Resources:**


1. "Wireless Networks – Design & Integration for LTE, EVDO, HSPA and WiMAX", Clint Smith & Daniel Collins, 3rd Edition, McGrow Hill, 2014.
2. "Vehicular ad hoc Networks - Standards, Solutions, and Research", Editors: Campolo, Claudia, Molinaro, Antonella, Scopigno, Riccardo (Eds.), Springer 2015.
3. "Wireless Sensor Networks - Technology, Protocols, and Applications", KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, Wiley Publications.
4. "Wireless Sensor Networks", Edited by C. S. RAGHAVENDRA, KRISHNA M. SIVALINGAM, TAIEB ZNATI, Springer 2011.
5. Springer Journal on Signals & Communications, http://www.springer.com/engineering/signals/journal/11276


Mapping COs with POs (Program outcomes)

| Course Outcomes | Program Outcomes | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** | **PSO3** |
| CO1 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 1 | 2 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 1 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 2 | 1 | 1 | 1 |
| CO4 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | 1 | 1 | 2 | 2 |

Where, 1 (Low), 2 (Medium) and 3 (High) represents strength of correlation between CO and PO

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs/ Wk. |
|---|---|---|---|---|---|---|---|---|
| **M18CS3020** | Internet Computer and Applications | **16** | **OE** | 3 | 1 | 0 | 4 | **5** |

A set of certification programs are offered to enable students to acquire various skills apart from the subject knowledge in their respective areas. A Certification after studying a set of courses in a particular field lead to certificate status or a license to practice. Certification proves to you and to potential employers that you have attained certain knowledge of and experience in your field.

| Course Code | Course Title | Duration (Weeks) | Course Type | L | T | P | C | Hrs/ Wk. |
|---|---|---|---|---|---|---|---|---|
| **M18CS3030** | **Minor Project/Internship** | **16** | **HC** | **0** | **0** | **2** | **2** | **4** |

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

**FOURTH SEMESTER**

| Course Code | Course Title | Duration (Weeks) | Course | L | T | P | C | Hrs./ |
|---|---|---|---|---|---|---|---|---|
| **M18CS4010** | **Project Work and Dissertation** | **16** | **HC** | **2** | **4** | **14** | **20** | **40** |

# Career Development and Placement

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

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

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

The need of the hour in the field of Commerce is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with

utmost care.

The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs.
REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana.

The various skill/certification programs identified are as follows:

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

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

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## DO'S AND DON'TS

**DO'S**

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

**DON'TS**

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

**Note:** 1. Rules are revised / reviewed as and when required.

2. Healthy suggestions are welcome for betterment of Institution