REVA UNIVERSITY
Bengaluru, India

SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

M. TECH - COMPUTER SCIENCE AND ENGINEERING HANDBOOK

2019-22

Rukmini Educational
Charitable Trust

REVA UNIVERSITY
Bengaluru, India

SCHOOL OF COMPUTING & INFORMATION TECHNOLOGY

HANDBOOK

M. Tech. in Computer Science and Engineering

2019-21

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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 to change the world."

- Nelson Mandela.

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

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

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

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

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

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

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

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

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

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

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students become skilled with relevant to industry requirements. Structured training programs on soft-skills and preparatory training for competitive exams are offered here to make students more employable. 100% placement of eligible students speaks the effectiveness of these programs. The entrepreneurship

development activities and establishment of "Technology Incubation Centers" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

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

Welcome to the portals of REVA University!

Dr. S Y KulkarniVice-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 inIndustry 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 theareas 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 twoSemesters. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization.The important features of the M.Tech CSE are as follows: 1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, Genetic Engineering, NLP, Swarm Intelligence, IOT and Cybersecurity, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft 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

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. Rukmini Shyama Raju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini Shyama Raju came true with the establishment of Rukmini Educational Charitable Trust (RECT), in the year 2002. Rukmini Educational Charitable Trust (RECT) is a Public Charitable Trust, set up in 2002 with the objective of promoting, establishing and conducting academic activities in the fields of Arts, 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 two undergraduate programs: B Tech in Computer Science and Engineering and B Tech in Computer Science and Information Technology. Three postgraduate programs offered in the school are: M Tech in Data Science, 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.

Advisory Board

SI.No	Name and Designation of the Members
1	Mr. Himesh Misra,Program Director, IBM Innovation Center, IBM India Private Limited Bengaluru-560017
2	Dr. Rajkumar Buyya,Director, Cloud Computing and Distributed Systems Laboratory Department of Computing and Information Systems University of Melbourne, Australia
3	Mr. Chethan Shivkumar, Founding Director, AIKAAN Labs, Bengaluru
4	Mr. P. B. Kotur, Global Goodwill Ambassador Wipro Limited Bengaluru, India
5	Dr. Sajal Das, Professor, Department of CS&E Missouri University of Science and Technology, USA
6	Dr. Heggere S Ranganath, Professor and Chair, Computer Science Department University of Alabama in Huntsville Huntsville, AL 35899, USA
7	Mr. Mrityunjay Hiremath, Director, AMD Inc. USA, Bengaluru
8	Dr. Shirshu Verma, Professor and Registrar, IIIT Allahabad Allahabad, India

9	Dr. K. Gopinath, Professor, Dept. of Computer Science and Automation IISc., Bengaluru
10	Dr. S. S. Iyengar,Professor, Louisiana State University (LSU), USA.

MEMBERS OF BOARD OF STUDIES

Sl. No	Name and Affiliation	Role
1	Dr Sunil Kumar S Manvi, Professor and Director School of C & IT, REVA University	Chairman
2	Dr Mallikarjuna Shastry P M, Professor School of C & IT, REVA University	Member
3	Dr Kiran Kumari Patil, Director UIIC REVA University	Member
4	Dr Mallikarjuna M Kodabagi, Professor and Deputy Director IQAC, REVA University	Member
5	Dr Ashwin Kumar U M, Professor , School of C & IT, REVA University	Member
6	Dr Gopala Krishna Shyam, Professor, School of C & IT, REVA University	Member
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10	Dr Sanjay, HoD Dept. of ISE, NITTE Meenakshi Institute of Technology, Bengaluru	Member
11	Dr Raghavendra Kulkarni, Director of Academics, M. S. Ramaiah University of Applied Sciences, Bengaluru	Member

Program Overview

M Tech (Computer Science & Engineering) Program

Computer Science Engineering (CSE) encompasses a variety of topics that relates to computation, like development of algorithms, analysis of algorithms, programming languages, software design and computer hardware. Computer Science engineering has roots in electrical engineering, mathematics, and linguistics. In the past Computer Science was taught as part of mathematics or engineering departments and in the last 3 decades it has emerged as a separate engineering field. 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 opportunities the graduates find.

The School of Computing and Information Science at REVA UNIVERSITY offers M.Tech., Computer Science and Engineering programme to create motivated, innovative, creative thinking graduates 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 Computer Science and Engineering.

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

1.0 Teaching and Learning Process

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

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

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

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

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

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

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

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

(ii) Foundation Course (FC):

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

(iii) Hard Core Course (HC):

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

(iv) Soft Core Course (SC):

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

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

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

2.2. Project Work:

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

2.3. Minor Project:

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

2.4. Major Project / Dissertation:

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

3.0. Minimum Credits to be earned:

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

3.2. A candidate can enroll for a maximum of 26 credits per Semester. However he / she may notsuccessfully earn a maximum of 26 credits per semester. This maximum of 26 credits does not include the credits of courses carried forward by a candidate.

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

4.0. Add- on Proficiency Certification:

In excess to the minimum of 96 credits for the M. Tech Degree program, a candidate can opt to complete a minimum of 4 extra credits either in the same discipline/subject or in different discipline / subject to acquire **Add on Proficiency Certification** in that particular discipline / subject along with the M .Tech degree.

4.1. Add on Proficiency Diploma:

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

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

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

(i) Component C1:

The first Component (C1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th 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 process 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 valuationand 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 CGPA
Illustration No. 1

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

Thus, **SGPA = 200 ÷ 24 = 8.33**

Illustration No. 2

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

Thus, **SGPA = 205 ÷ 24 = 8.54**

9.5 Cumulative Grade Point Average (CGPA):

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

CGPA = ∑(Ci x Si) / ∑Ci

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

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

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	24	8.33	24 x 8.33 = 199.92
2	24	8.54	24 x 8.54 =204.96
3	24	9.35	24x9.35=224.4

4	24	9.50	24x9.50=228.0
Cumulative	96		857.28

Thus, **CGPA** = 24x8.33+24x8.54+24x9.35+24x9.50 = 8.93
96

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

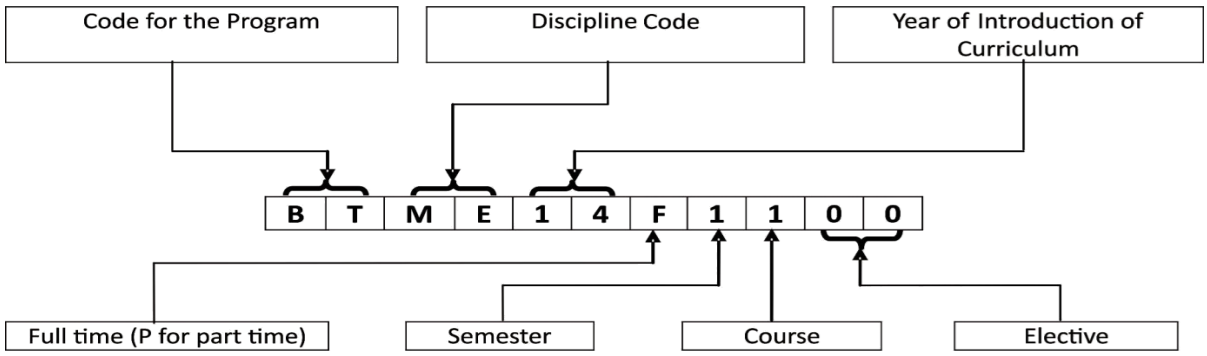
For every program there will be one grievance cell. The composition of the grievance cell is as follows:-

- The Registrar (Evaluation) - Ex-officio Chairman / Convener

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

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

Course Numbering Scheme



List of Codes for Programs and Disciplines / Branch of Study

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

MC	M.Com (Master of Commerce)	EN	English
MS	M.Sc / MS (Master of Science)	MD	Machine Design and Dynamics
MT	M Tech (Master of Technology)	ME	Mechanical Engineering
MC	Master of Computer Applications	EE	Electrical & Electronics Engineering

Mtech (Part Time) in Computer Science and Engineering

Scheme of Instruction for Academic Year 2019-22

Eligibility: Pass in B E / B Tech in ECE / IT / EEE / CSE / ISE / TE , MCA / M.Sc in Computer Science with a minimum of **50% (45% in** case of SCs/STs) marks in aggregate of any recognized university / institution or AMIE or any other qualification recognized as equivalent there to.

Scheme of Instruction **Intake: 36**

Sl. No	Course Code	Title of the Course	Course Typ	Credit Pattern				Hrs/week
				L	T	P	Total	
FIRST SEMESTER								
1	M19TCS1010	Advanced Database Management Systems	HC	4	0	0	4	6
2	M19TCS1020	Machine Learning	HC	4	0	0	4	6
3	M19TCS1031	Wireless Networks	SC	4	0	0	4	4
	M19TCS1032	Distributed Computing						
	M19TCS1033	Advanced Java Programming						
4	M19TCS1040	ADBMS LAB	HC	0	0	2	2	2
Total Credits for Second Semester							**14**	
SECOND SEMESTER								
1	M19TCS2010	Cloud Computing	HC	4	0	0	4	4
2	M19TCS2020	Big Data Analytics	HC	4	0	0	4	4
3	M19TCS2031	Python for Data Analysis	SC	4	0	0	4	4
	M19TCS2032	Parallel Computing and Programming						
	M19TCS2033	Open Source Cloud Computing Tools						
4	M19TCS2040	Bigdata & Analytics Lab	HC	0	0	2	2	4
Total Credits for Second Semester							**14**	
THIRD SEMESTER								
1	M19TCS3010	Advanced Algorithms	HC	3	0	1	4	5

2	M19TCS3020	Internet of Things	HC	4	0	0	4	4
3	M19TCS3031	Data Science using R	SC	4	0	0	4	4
	M19TCS3032	Research Methodology						
	M19TCS3033	Mobile Application Development						
4	M19TCS3040	Advanced Web Technologies Lab	HC	0	0	2	2	2
	Total Credits for Third Semester						**14**	

Sl. No	**Course Code**	**Title of the Course**	**Course Type**	**Credit Pattern**				**Hrs /WK.**
				L	**T**	**P**	**C**	
FOURTH SEMESTER								
1	M19TCS4010	Agile Software Development	HC	4	0	0	4	4
2	M19TCS4021	Unix System Programming	SC	4	0	0	4	4
	M19TCS4022	Program Analysis						
	M19TCS4023	UI/UX Design						
3	M19TCS4031	Robotic Process Automation Design & Development	SC	4	0	0	4	4
4	M19TCS4032	Block Chain Technology						
	M19TCS4033	Deep Learning						
	M19TCS4040	Cyber Security lab	HC	0	0	2	2	2
Total Credits for Fourth Semester							**14**	
FIFTH SEMESTER								
1	M19TCS5011	Virtual and Augmented Reality	SC	3	0	0	3	4
	M19TCS5012	Computer Vision						
	M19TCS5013	Data Privacy						
2	M19TCS5020	Project Work Phase-1	HC	0	0	4	4	4
3	M19TCS5030	MOOC - 1	HC	-	-	4	4	4
4	M19TCS5040	MOOC - 2	HC	-	-	4	4	4
5	M19TCS5040	Global Certification	HC	-	-	4	4	4
Total Credits for Fifth Semester							**19**	

SIXTH SEMESTER								
1	M19TCS6010	Project-Work Phase-2 and Dissertation	HC	2	4	14	16	40
2	M19TCS6020	MOOC - 3	HC	2	0	1	3	4
3	M19TCS6030	Sports ,Yoga, Music ,Dance, Theatre	RULO	-	-	2	2	4
Total Credits for Sixth Semester							**21**	
Total Credits for whole Program :96								

M Tech (Computer Science and Engineering) (Part TIME)

Detailed Syllabus

Course Code	Course Title	Duration		L	T	P	C
M19CS1010	Advanced Database Management Systems	16 Weeks	HC	4	0	0	4

Course Descriptions:

This course introduces to new database technology with emphasis on object orientation. The focus is mainly on the data modeling aspect. The course gives an overview of motivation and background of the new developments, and is intended as an introduction to the most important advances with respect to the classical relational database systems. Effective collection, analysis, and maintenance of data is key to achieve rapid progress in almost all disciplines of science and engineering. This course covers the core principles and techniques of data and information management such as Object oriented concepts in relational databases, Architectures of Parallel and Distributed databases OLAP, Enhanced Data Models for Advanced Applications.

Course Objectives:

The objectives of this course are to:

Explain the concepts of DBMS and SQL

Discuss the Object oriented concepts and object relational Databases

Demonstrate the use of parallel and distributed databases in real world applications

Illustrate the development of Enhanced Data Model for given applications.

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

Overview of DBMS and SQL:

Introduction to DBMS and SQL, SQL Data Definition and Data Types, Schema change statements in SQL, Specifying basic constraints in SQL, Basic Queries in SQL, More Complex Queries in SQL, General Constraints as Assertions, Views in SQL, Database Programming, Embedded 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- 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; OLAP - OLAP Architecture, Relational OLAP , Multidimensional OLAP , Relational vs. Multidimensional OLAP , Web based OLAP Major features & functions , Drill-Down and Roll-Up , Slice-and-Dice or Rotation

Self-Learning Component:

Data warehousing, Data Marts, Getting data into the warehouse , Extraction , Transformation ,Cleansing , Loading, Summarization, Meta data, Data warehousing & ERP, Data warehousing & KM , Data warehousing & CRM , Data Mining , Data mining algorithms, Clustering, Classification, association rules, Knowledge discovery: KDD process, Decision trees ,

Recommended Learning Resources :(Text Books)

1. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw- Hill, 2003.

2. Elmasri and Navathe, Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.

Reference Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGraw Hill, 2010.
2. C J Date, Database Design and Relational Theory: Normal Forms and All that Jazz, O 'Reilly, April 2012.
3. 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. IEEE, IEEE Transactions on Knowledge and Data Engineering
6. Elsevier, Elsevier Data and Knowledge Engineering
7. ACM, ACM Transactions on Database Systems
8. Journal of Data and Information Quality (JDIQ)
9. ACM Transactions on Knowledge Discovery from Data (TKDD)

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	2	1	1	2	2	1	1
CO2	3	3	2	3	2	2	1	2	3	2	1	2
CO3	1	2	3	1	2	1	3	1	3	2	2	1
CO4	3	3	3	3	3	3	3	2	2	2	1	3

Where, (1), M (2) and H (3) represents strength of correlation between CO ,PO and PSO

Course Code	Course Title	Duration		L	T	P	C
M19CS1020	Machine Learning	16 Weeks	HC	4	0	0	4

Course Descriptions:

The course introduces machine learning, with various aspects involved in machine learning, types of learning like supervised, unsupervised and reinforcement learning. It also introduces various methods of dimensionality reduction, reasons for dimensionality reduction, concepts of neural networks, different aspects involved in neural networks, their activation function, back propagation algorithm etc.

Course Objectives:

The objectives of this course are to:

Explain the basic blocks of machine learning and the techniques involved.

Discuss the various Learning trees used in real world problems.

Illustrate the use of different Linear Models in real world problems

Demonstrate the use of different dimensionality reduction techniques.

Course Outcomes:

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

CO1 Apply the basic blocks of machine learning and the techniques involved

CO2. Analyze the various Learning trees used in real world problems.

CO3. : Design simple linear models to solve real world problems.

CO4. Formulate different dimensionality reduction techniques to real world problems.

Course Contents:

Unit-1

Introduction : Learning – Types of Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm –– Inductive bias [1] , Bayesian Learning [1]

Learning with trees: Learning with Trees, Decision Trees, Constructing Decision Trees, Classification and Regression Trees.

Unit-2

Learning with trees (contd...): Boosting, Bagging, Random Forest, Different ways to combine Classifiers

Probabilistic Learning – Gaussian Mixture Models, Nearest Neighbor Methods [2]

Support Vector Machines - Optimal separation, kernels, the support vector machine algorithm, extensions to the SVM

Unit-3

Linear models: Perceptron, Linear Separability, Linear Regression.

Multi-layer Perceptron, Going Forwards, Going Backwards: Back Propagation Error, Multi-layer Perceptron in Practice, Examples of using the MLP, Overview, and Deriving Back-Propagation

Unit-4

Dimensionality reduction and evolutionary models, Dimensionality Reduction - Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis .

Unsupervised learning: Different types of clustering methods, K means Algorithms, Vector Quantization, and Self-Organizing Feature Map

Unsupervised learning: Classification, Association

Self- Learning:

Reinforcement learning -Introduction, Learning task, Q-learning –Qfunction, An Algorithm for Learning Q, An Illustrative Example, Convergence, Experimentation Strategies, Updating Sequence, Nondeterministic Rewards and Actions, Temporal Difference Learning.

Recommended Learning Resources (Text Books):

Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Stephen Marsland, —Machine Learning – An Algorithmic Perspective||, Second Edition, Chapman and Hall/CRC

Machine Learning and Pattern Recognition Series, 2014.

Recommended Learning Resources (Reference books):

1. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)||, Third Edition, MIT Press, 2014
2. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data||, First Edition, Cambridge University Press, 2012.
3. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals||, First Edition, Wiley, 2014
4. Machine Learning A-Z™: Hands-On Python & R In Data Science
5. https://www.udemy.com/machinelearning/
6. https://www.coursera.org/learn/machine-learning
7. https://nptel.ac.in/courses/106106139/

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3							3
CO2	3	3	3	3	3							3
CO3	3	2	2	2	3							2
CO4	3	3	2	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		L	T	P	C
M19CS1030	Advanced Algorithms	16 Weeks	HC	4	0	0	4

Course Descriptions:

Emphasis is placed on fundamental **algorithms** and **advanced** methods of algorithmic design, analysis, and implementation. ... Domains include string **algorithms**, network optimization, parallel **algorithms**, computational geometry, online **algorithms**, external memory, cache, and streaming **algorithms**, and data structures..

Course Objectives:

The objectives of this course are to:

Explain the problem solving methods and provide a solid foundation in algorithm design and analysis.

Discuss sorting & string matching algorithmic design paradigms.

Demonstrate a familiarity with major algorithms and data structures related to graph.

Design efficient algorithms for common engineering problems.

Course Outcomes:

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

CO1: Apply iterative and recursive algorithms to model engineering problems in real world

CO2: : Experiment with different sorting and string matching algorithms for real time data sets..

CO3: Analyse the search and graph algorithms for real world applications

CO4: Make use of Number Theoretic Algorithms and Probabilistic and Randomized Algorithms in real world applications.

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 nalyzing some basic comparison based list algorithms – Asymptotic behavior of Functions – Asymptotic order formulae for three important series – Recurrence relations for complexity – Mathematical induction and proving the correctness of algorithms – Establishing lower bounds for problems.

UNIT-2

Sorting and string matching Algorithms: Merge Sorting and its analysis, Quick Sorting and its Analysis, Bubble Sort, Selection Sort, Shell sort, Bingo sort and Radix sort. String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.

UNIT-3

Trees & Applications of Algorithms: Mathematical properties of Binary trees – implementation of trees and forests – Tree traversal – Binary search trees – Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Flow networks and Ford-Fulkerson method; maximum bipartite matching. Extending the Limits of Tractability: Finding small vertex covers, Coloring a set of circular arcs, Tree decompositions of Graphs.

UNIT-4

Number Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Primality testing; Integer factorization. Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Self-Learning Component:

Mathematical induction and proving the correctness of algorithms – Establishing lower bounds for problems. Naïve string Matching; Mathematical properties of Binary trees – implementation of trees and forests – Tree traversal – Binary search trees.

Recommended Learning Resources (Text Books):

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010. 2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.
2. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson, 2016
3. Kenneth A. Berman, Jerome L. Paul, Algorithms, Cengage Learning, 2008.

4. Recommended Learning Resources (Reference books):

5. Anany Levitin, Introduction to the Design & Analysis of Algorithms, Pearson, 2013

6. Ellis Horowitz, SartajSahni, S. Rajasekharan, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2007.

7. J. Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005.

8. V. Aho, J. E. Hopcraft, and J. D. Ullman, Design and Analysis of Algorithms, Addison-Wesley, 1974.

9. ACM Transactions on Algorithms

10. ACM Transactions on Modeling and Computer Simulation (TOMACS)

11. 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	PO12
CO1	3									3		
CO2	3	3	3		3					3		
CO3	3	3	3		3					3	2	
CO4	3									3	2	

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS3020	Internet of Things	16 Weeks	HC	4	0	0	4

Prerequisites:

Knowledge in basic electronics, Computer Networks, DBMS

Course Description:

This course introduces the Concept of connecting processing devices together through a network using which things can communicate with each other using internet as means of communication between them. All the things should be IP protocol enabled in order to have this concept possible. Not one but multiple technologies are involved to make IoT a great success.

Course Objectives:

The objectives of this course are to:

1. Explain the basics of embedded systems and embedded system design.

2. Describe Internet-of-Things and design principles.

3. Demonstrate the use of prototyping in development of real world application.

4. Illustrate the use of internet principles and techniques for writing embedded code.

Course Outcomes:

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

CO1: Summarize the foundation in the Internet of Things, including the components, tools, and analysis.

CO2: Apply Internet-of-Things and design principles in development of real-world applications.

CO3: Design prototypes forimplementing IoT in Big Data and understand the utilization and modelling of extracted data development of real-world application.

CO4: Develop embedded IoT Solutions using sensors and components integration for the real time application.

Course Contents:

UNIT-1

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-2

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-3

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-4

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.

Self-Learning Component:

Various sensors available in market – application of various sensor – Their specifications – code used to connect these sensors into Microcontroller board – Various microcontroller boards available in market – Arduino IDE download – usage of this IDE to carryout projects.

Recommended Learning Resources (Text books):

1. Arshdeep Bahga , Vijay audisetti, Internet of Things, A Hands on Approach, University Press, 2014.
2. The Internet of Things, by Michael Millen, Pearson, 2015.
3. Recommended Learning Resources (Reference books):
4. Adrian McEwen & Hakim Cassimally, Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication, 2013
5. Dr. Ovidiu Vermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers, 2013
6. IEEE Transactions on Wireless Communications
7. IEEE Sensors Journal
8. IEEE Internet of Things Journal
9. Elsevier, Journal of Network and Computer Applications,
10. Elsevier, Computer Law & Security Review
11. 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	PO12
CO1	3	2	2	3	3							
CO2	2	1	3	3	2							
CO3	3	2	2	3	3							
CO4	3	2	2	3	3							

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS1031	Wireless Networks	16 Weeks	SC	4	0	0	4

Course Descriptions:

A wireless network is a computer network that uses wireless data connections between network nodes. Wireless networking is a method by which homes, telecommunications networks and business installations avoid the costly process of introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are generally implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure. Examples of wireless networks include cell phone networks, wireless local area networks (WLANs), wireless sensor networks, satellite communication networks, and terrestrial microwave networks

Course Objectives:

The objectives of this course are to:

Explain the different concepts of wireless media, communication and networks;

Describe the Wireless Body Area network and Personal Area Network;

Discuss the concepts of Wireless Local Area Network and Wide Area Network;

Demonstrate Wireless Ad Hoc Networks.

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

Course Outcomes:

CO-1: Summarize the different concepts of wireless media, communication and networks;

CO-2: Develop the applications using WBAN and WPAN;

CO-3: Make use of WLAN and WWAN in real world scenario.

CO-4: Analyze the research Issues in Wireless networks.

Course Contents:

Unit 1

Fundamentals of wireless communication: Wireless Communication System, Wireless Media, Frequency spectrum, Technologies in Digital Wireless Communication, Wireless Communication Channel Specifications, types of Wireless Communication systems.

Fundamentals of wireless Networks: Wireless Personal Area Network, wireless Switching Technology, Wireless Network reference Model, Wireless Networking issues, Wireless Networking standards.

Unit- 2

Wireless Body Area Networks: properties, Network Architecture, Network components, Design issues, Network protocols, WBAN technologies, WBAN applications.

Wireless personal Area Networks: Network Architecture, WPAN components, WPAN technologies and protocols, WPAN applications.

Unit- 3

Wireless Local Area Networks: Network components, Design requirements of WLAN, Network Architecture, WLAN standards, WLAN protocols, IEEE 802.11p, WLAN applications.

Wireless wide Area Networks: Cellular networks, satellite networks, WLAN versus WMAN, Interworking of WLAN and WMAN, WMAN applications.

Unit- 4

Wireless Ad Hoc Networks: Features of Ad Hoc Networks, Mobile Ad Hoc networks, wireless Sensor networks, Wireless mesh networks, vehicular Ad Hoc Networks.

Research issues in Wireless networks: Modulation, Radio Resource management, channel Allocation, error control and coding, congestion control, Routing, Addressing and network Access control.

Self-Learning Component:

Flow control, Security and privacy, QOS management, Power management, Cross-layer Control, Network modelling, Traffic Modelling, Simulation modelling and network measurements

Recommended Learning Resources: (Text Books)

1..SunilKumar S. Manvi and Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks concepts and Protocols", wiley publications, 2nd edition,2016

2. Asoke K. Talukder, Roopa R.Yavagal, Mobile Computing-Technology, Applications and Service Creation, Tata McGraw Hill, 2010.

Recommended Learning Resources (Reference books):

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of wireless sensor Networks - theory and practice", John Wiley & Sons, 2010

2. Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", John Wiley & Sons, 2010

3. C. Siva Ram Murthy, B. S. Manoj, "Ad Hoc Wireless Networks – Architecture and Protocols", Pearson Education, 2010

4. ACM Transactions on Sensor Networks (TSON)

5. IEEE Transactions on Wireless Communications

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	3	3	2	0	0	0	0	0	0	0
CO 2	3	3	3	2	2	0	0	0	0	0	0	0
CO 3	2	3	2	3	3	0	0	0	0	0	0	0
CO 4	2	3	2	3	2	0	0	0	0	0	0	0

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS1032	Distributed Computing	16 Weeks	SC	4	0	0	4

Course Descriptions:

The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and how they meet the demands of contemporary distributed applications. The course covers the building blocks for a study of distributed systems, and addressing the characteristics and the challenges that must be addressed in their design: scalability, heterogeneity, security and failure handling being the most significant.

Course Objectives:

The objective of the course is to

Explain the various distributed systems and its architectures

Discuss various communication aspects in the distributed systems

Describe the consistency and replication, fault tolerance and security aspects

Illustrate the use of Distributed-Object based Systems, Distributed File Systems and Distributed Web-based Systems in real world applications.

Course Outcomes:

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

CO1: Apply the concepts of distributed computing systems

CO2: Analyze the various communication aspects in the distributed systems

CO3: Design applications for consistency and replication, fault tolerance and security aspects

CO4: Make use of Distributed-Object based Systems, Distributed File Systems and Distributed Web-based Systems in real world applications

Course Contents:

Unit-1

Introduction: Introduction to distributed systems; goals; types of distributed systems

Architecture: Architectural styles; system architectures; architectures versus middleware; self-management in distributed systems

Processes: Threads; virtualization; clients; servers; code migration

Unit-2

Communication: Remote procedure calls; message-oriented communication; stream-oriented communication; multicast communication

Naming: Names, identifiers and addresses; flat naming; structured naming; attribute-based naming

Synchronization: Clock synchronization; logical clocks; mutual exclusion; global positioning of nodes; election algorithms

Unit-3

Consistency and Replication: Introduction; data-centric consistency models; client-centric consistency models; replica management; consistency protocols

Fault Tolerance: Introduction; process resilience; reliable client-server communication; reliable-group communication; distributed commit; recovery

Security: Introduction; secure channels; access control; security

management Unit-4

Distributed-Object based Systems:

Architecture; Processes; Communication; Naming; Synchronization; Consistency and Replication; Fault Tolerance; Security

Distributed File Systems: Architecture; Processes; Communication; Naming; Synchronization; Consistency and Replication; Fault Tolerance; Security

Distributed Web-based Systems: Architecture; Processes; Communication; Naming; Synchronization; Consistency and Replication; Fault Tolerance; Security

Self-learning Component:

Explore the tools used in distributed computing: Availability Monitoring, Capacity and Performance Monitoring, Security Events Monitoring.

Recommended Learning Resources (Text books):

1. Andrew S. Tanenbaum, Distributed Operating System, Pearson, 2008.
2. George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems: Concepts and design, (4 th ed.) Pearson, 2011.

3. Recommended Learning Resources (Reference books):

4. Andrew S. Tanenbaum, Maarten Van Steen, Distributed Systems: Principles and Paradigms (2nd ed.), Pearson, 2007.

5. Pradeep K. and Sinha, Distributed Operating System: Concepts and Design (2nd ed.), PHI, 2009.

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	1	1	1	1	1
CO2	3	3	3	3	2	1	1	1	1	1	1	1
CO3	3	3	3	3	2	1	1	1	1	1	1	1
CO4	3	3	3	3	2	1	1	1	1	1	1	1

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS1033	Advanced Java Programming	16 Weeks	SC	4	0	0	4

Course Descriptions:

Advanced Java is everything that goes beyond Core Java – most importantly the APIs defined in Java Enterprise Edition, includes Servlet programming, Web Services, the Persistence API, etc. It is a Web & Enterprise application development platform which basically follows client & server architecture. Advance Java i.e. JEE (Java Enterprise Edition) gives you the library to understand the Client-Server architecture for Web Application Development. This course focuses on advanced concepts in the java programming starting from basic concepts of classes, objects, java database connection, servlets-The technology is used to create a web application (resides at server side and generates a dynamic web page) and java server pages, using which windows, web applications can be developed

Course Objectives:

The objectives of this course are to:

1. Describe the advanced concepts of java programming.

2. Explain the concepts used for developing web application.

3. Discuss different session management techniques used in web pages.

4 Demonstrate the establishment of communication between application and databases.

Course Outcomes:

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

CO1: Summarize the fundamentals of Java like object oriented programming, exception handling and multithreading to solve real world problems.

CO2: Choose proper component, like java servlets, java server pages etc., to develop a web application using J2EE

CO3: Apply advanced java concepts to manage sessions and cookies for optimal performance CO4: Develop an application to establish communication between application and database..

Course Contents:

Unit-1

Introduction to Java: Java and Java applications; Java Development Kit (JDK); Java is interpreted, Byte Code, JVM; Object-oriented programming; Classes: Classes in Java; Inheritance: Simple, multiple, and multilevel inheritance; Overriding, overloading. Exception handling: Exception handling in Java

Multi-Threaded Programming: What are threads? How to make the classes threadable; Extending threads; Implementing runnable; Synchronization; Changing state of the thread;

Unit-2

Java 2 Enterprise Edition Overview, Database Access : Overview of J2EE and J2SE The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Resultset; Transaction Processing; Metadata, Data types; Exceptions.

Unit-3

Servlets : Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking.

Unit-4

JSP, RMI : Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects. Java Remote Method Invocation: Remote Method Invocation concept; Server side, Client side. IDE: Eclipse IDE, Netbeans IDE & Myeclipse IDE; Servers: Apache Tomcat Glassfish Server, JBoss Server & Weblogic Server.

Self-learning Component:

JAVA Model-View-Controller Pattern & Spring Framework.

Recommended Learning Resources (Text books):

1. Head First Servlets & JSP, Bryan Basham, Kathy Sierra & Bert Bates, 2nd Edition.
2. Barry J. Holmes and Daniel T. Joyce, Object-Oriented Programming With Java; Second Edition; Jones And Bartlett Publishers,2000
3. Dale Skrien; Object-Oriented Design Using Java; McGraw-Hill Higher Education; 2009
4. Danny Poo; Object-Oriented Programming and Java; Second Edition; Springer; 2008.

Recommended Learning Resources (Reference books):

1. Cay Horstmann; Big Java; 2nd Edition ; John Wiley and Sons
2. Herbert Schildt; The Complete Reference Java J2SE; 5th Edition; TMH Publishing Company Ltd, New DelhI

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2				3	3	1	1
CO2	2	2	1	2	2					1		
CO3	2	2	1	2	2				1		1	
CO4	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		L	T	P	C
M19TCS3010	Data Science using R	16 Weeks	SC	4	0	0	4

Course Descriptions:

This course will introduce students to this rapidly growing field and equip them with some of its basic principles and tools as well as its general mindset. Students will learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration, exploratory data analysis, predictive modeling, descriptive modeling, data product creation, evaluation, and effective communication. The focus in the treatment of these topics will be on breadth, rather than depth, and emphasis will be placed on integration and synthesis of concepts and their application to solving problems. To make the learning contextual, real datasets from a variety of disciplines will be used. Data Science is the study of the generalizable extraction of knowledge from data. Being a data scientist requires an integrated skill set spanning mathematics, statistics, machine learning, databases and other branches of computer science along with a good understanding of the craft of problem formulation to engineer effective solutions.

Course Objectives:

The objectives of this course are to:

1. Explain data science concepts and methods to solve problems in real- world contexts and will communicate these solutions effectively

2. Illustrate using R programming.

3. Demonstrate and implement machine learning algorithms.

4. Develop the ability to build and assess data based models.

Course Outcomes:

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

CO1: Discuss the basics of Data Science and its applications.

CO2: Demonstrate the programs and packages available in R Programming using Real Time datasets..

CO3: Analyze the Machine learning algorithms using Real time data sets.

CO4: Apply Logistic Regression model using R Programming.

Course Contents:

Unit-1

Introduction: What Is Data Science? Big Data and Data Science Hype, Getting Past the Hype, Why Now?, Datafication, The Current Landscape (with a Little History), Data Science Jobs , A Data Science Profile, Thought Experiment: Meta-Definition OK, So What Is a Data Scientist, Really?, In Academia, In Industry

Statistical Inference, Exploratory Data Analysis, and the Data Science Process: Statistical Thinking in the Age of Big Data, Exploratory Data Analysis, The Data Science Process,

Case Study:

RealDirect Unit-2

R-programming : History and overview of R: R nuts and bolts, Getting Data In and Out of R, Interfaces to the Outside World, Subsetting R Objects, Managing Data Frames with the dplyr package, Control structures, Functions, Loop functions, R Graphics: Quickly exploring data, Bar graphs: Making a Basic Bar Graph, Grouping Bars Together, Making a Bar Graph of Counts, Using Colors in a Bar Graph, Line graphs: Making a Basic Line Graph, Adding Points to a Line Graph, Making a Line Graph with Multiple Lines, Changing the Appearance of Lines, Changing the Appearance of Points, Making a Graph with a Shaded Area, Scatter plots: Making a Basic Scatter Plot,

Unit-3

Machine Learning Algorithms, Three Basic Algorithms, Linear Regression, k-Nearest Neighbors (k-NN),k-means, Exercise: Basic Machine Learning Algorithms Solutions, Naive Bayes 98 Bayes Law 98 A Spam Filter for Individual Words 99 A Spam Filter That Combines Words: Naive Bayes, Comparing Naive Bayes to k-NN,

Case study: Jake's Exercise: Naive Bayes for Article Classification.

Unit-4

Logistic Regression: Thought Experiments, Classifiers, Runtime, Interpretability, Scalability, M6D Logistic Regression Case Study, Estimating α and β, Newton's Method, Stochastic Gradient Descent, Implementation, Evaluation, Sample R Code.

Self-Learning Component:

Amazon Case Study: Big Spenders, Breast Cancer Detection, Pneumonia Prediction.

Recommended Learning Resources (Text books):

1. Rachel Schutt and Cathy O'Neil, " Doing Data Science", Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472,2013.
2. Roger D. Peng, "R Programming for Data Science", Leanpub, 2015

3. Winston Chang, "R Graphics Cookbook Practical Recipes for Visualizing Data", O'Reilly Media, 2012

4. Kuhn, Max, Johnson and Kjell, "Applied Predictive Modeling", Springer eBook, 2012.

Recommended Learning Resources (Reference books):

1. John Maindonald, W. John Braun, "Data Analysis and Graphics Using R – an Example Based Approach", 3rd Edition, Cambridge University Press, 2010. (Unit 1 & 2)

2. Johannes Ledolter, "DATA MINING AND BUSINESS ANALYTICS WITH R", WILEY, 2013. (Unit 3)

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) (Unit 4)

4. Springer, International Journal of Data Science and Analytics.

5. Elsevier, Computational Statistics & Data Analysis

6. 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	PO12
CO 1	3	3	L	3	3							
CO 2	3	2	2	3	3							
CO 3	3	3	2	3	3							
CO 4	3	3	2	3	2							

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS3032	Research Methodology	16 Weeks	SC	4	0	0	4

Course Descriptions:

This course offers "An overview of research methodology including basic concepts employed in quantitative and qualitative research methods. Includes computer applications for research. Prerequisites: Admission to the Doctoral Program. Note: Meets requirements for a Level I research tool course" (Graduate Catalog, 2012-2013, online version). This course introduces research methods as they apply to the higher education (HIED) field of study. HIED 695 provides a macro perspective of the methods associated with conducting scholarly research in all follow-on core, elective, quantitative and qualitative courses; and the doctoral dissertation. Completion of HIED 695 is a prerequisite for follow-on tools courses.

Course Objectives:

The objectives of this course are to:

Explain the dimensions and methods of research.

Illustrate the design of informed choice from the large number of alternative methods and experimental designs available

Describe the features of a good research proposal.

Discuss the skills required for undertaking a research project and preparing a technical paper.

Course Outcomes:

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

CO1. Identify and Formulate the research problem using state of art literature

CO2. Design the research for formulated problem.

CO3. Write the thesis/dissertation/technical document for the project.

CO4. Apply data preparation and statistical techniques on data.

Course Contents:

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 (Kothari)

Defining research problem: selecting the problem - necessity of defining the problem - techniques involved in defining a problem. (Kothari)

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. (Oliver, Stephen Covey, Slides from Net)

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. (Slides from net)

Thesis Writing: The preliminary pages and the introduction - the literature review - methodology - the data analysis - the conclusions - the Reference Books (in IEEE and ACM format). (Oliver, Slides from Net)

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. (Kothari)

Descriptive Statistics: measures of central tendency, dispersion, skewness, relationship, kurtosis, sampling distribution, central limit theorem, statistical inference (Kothari)

Introduction to Tools used in Computer Science: MATLAB, NS2/3, C, C++, Java, Web Service, SPSS, SAS, LOTUS, Excel, Latex and Ms Word. (From net)

Unit-4

Testing hypothesis: Concepts, testing, critical region, decision, and hypothesis testing for mean proportion and variance, limitations, chi-square test, one-way ANOVA. (Kothari)

Linear Regression Analysis: Simple model, multiple model and T-test. (Kothari)

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.

Self-learning component

Latex Tool

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 (Text Books):

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.

Recommended Learning Resources (Reference Books):

1. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 3nd. ed. Sage Publications, 2008.
2. Kumar, Research Methodology: A Step by Step Guide for Beginners, 2nd. ed. Indian: PE, 2005.
3. B. C. Nakra and K. K. Chaudhry, Instrumentation, Measurement and Analysis,2nd. ed. New Delhi: TMH publishing Co. Ltd., 2005.
    I. Gregory, Ethics in Research, Continuum, 2005.
4. COLIN NEVILLI, " The complete guide to referencing and avoiding plagiarism" , Second Edition published by Open Up Study Skills.
5. RUDRA PRATAP , " Getting Started with MATLAB " , published by Oxford University Press-2010
6. Teerawat, Issariyakul, Ekram, Hossain – 2008 , "Introduction to Network Simulator NS2"
7. https://www.stir.ac.uk/media/services/registry/quality/BookofPlagiarism.pdf
8. ceur-ws.org/Vol-706/poster22.pdf
9. https://books.google.co.in/books?isbn=1446281094

10. www.nalsarpro.org/pl/projects/modelproject2.pdf

11. www.uninova.pt/cam/teaching/SRMT/SRMTunit11.pdf

12. 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	PO12
CO1	2	3	-	L	2	-	-	-	-	-	-	3
CO2	-	-	-	3	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	2	-	-	-	-	-	-	-

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS3033	Mobile Application Development	16 Weeks	SC	4	0	0	4

Course Descriptions:

This course introduces programming technologies, design and development tools related to mobile applications. Topics include accessing device capabilities, industry standards, operating systems, and programming for mobile applications using OS Software Development Kit (SDK).

Course Objectives:

The objectives of this course are to:

1. Explain basics of Mobile communication.
2. Demonstrate the use of fundamentals of Android Application development.
3. Illustrate the use of Menus and Graphics in app development.
4. Describe the concepts related to views and activity.

Course Outcomes:

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

CO1 Analyse Android Platform, its architecture and features.

CO2: Design and implementation of user interface, database and content providers.

CO3: Make use of activities, layouts and Graphics in the development of apps for android platform devices.

CO4: Evaluate multimedia, camera and location based services in Android application.

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 Application 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

Layouts, Menus and Graphics in Android:Menus: Options menu and app bar,Context menu and contextual action mode, Popup menu, Defining a Menu in XML, Creating an Options Menu, Changing menu items at runtime, Creating Contextual Menus, Creating Menu Groups, Adding Menu Items Based on an Intent.

Activity, Service, BroadcastReceiver 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.

Self-learning Component:

More Recent Applications: Multimedia;2D graphics ; networking support in Android, Introduction to IoS, App. Development.

Recommended Learning Resources (Text books):

1. Bill Phillips, Chris Stewart, and Kristin Marsican, Android Programming: The Big Nerd Ranch Guide pearson technology group,3rd Edition,2015

2. Barry Burd, Android Application Development All-in-One For Dummies ,wiley publisher,2nd Edition, 2012.

3. ZigurdMednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura,Programming Android: Java Programming for the New Generation of Mobile Devices,oiley,2nd Edition,2012.

Recommended Learning Resources (Reference books):

1. Greg Nudelman, Android Design Patterns: Interaction Design Solutions for Developer, wiley, 2013.
2. Jason Tyler, App Inventor for Android: Build Your Own Apps No Experience Required!, wiley,2011.
3. J.F.Dimarzio, Android programming with Android studio,wrox,4th edition ,2017
4. Maurice Sharp Erica Sadun Rod Strougo, Learning iOS Development-A Hands-on Guide to the Fundamentals of iOS Programming, Addison Wesley by Pearson Education, Inc.2014.
5. Wei-Meng Lee, Beginning Swift Programming, Wiley India Pvt. Ltd.,2018

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	1		1	2	2	1	1
CO2	3	3	2	3	2	2		2	3	2	1	2
CO3	1	2	3	1	2	1		1	3	2	2	1
CO4	3	3	3	2	2	1		2	2	2	1	1

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Duration		L	T	P	C
M19TCS3040	Advanced Database Management Systems Lab	16 Weeks	HC	4	0	0	4

Course Outcomes:

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

CO1: Design database schema for a given problem.

CO2: Populate the database for a specific application.

CO3: Develop the database for a real world application.

CO4: Construct database queries using SQL commands for an application

List of Programs:

Sl. No.	Program	Course Outcome	Program Outcome
1	Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, lines and words in the text entered using an alert message. Words are separated with white space and lines are separated with new line character	1, 2	a, b, e, k, l
2	Write a JavaScript program which takes user input as name, stores it in array and sort them alphabetically and displays it using alert box	1, 2, 3	a, b, d, k, n
3	Exception handling is the process of responding to exceptions when a computer program runs. An exception occurs when an unexpected event happens that requires special processing. create an html page named to demonstrate exception handling in JavaScript	2, 3	a, b, c, k, i
4	Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following. (i). Create a Cookie and add these four user id's and passwords to this Cookie. (ii). Read the user id and passwords entered in the Login form (week1) and	1, 2, 3	a, b, e, k, l

	authenticate with the values (user id and passwords) available in the cookies. If he is a valid user (i.e., user-name and password match) you should welcome him by name (user-name) else you should display "You are not an authenticated user ". Finding Related Forum Posts through Content Similarity over Intention-based Segmentation		
5	JavaScript is mainly designed to add interactivity in the HTML pages. A JavaScript can be executed when an event occurs, like when a user clicks on an HTML element. To execute code when a user clicks on an element, add JavaScript code to an HTML event attribute Simple web application such as calculator, calendar can be developed using JavaScript. Design a scientific calculator using java script	3, 4	a, b, e, k, l
6	Install a database (Mysql or Oracle). Create a table which should contain at least the following fields: name, password, email-id, phone number Write a java program/servlet/JSP to connect to that database and extract data from the tables and display them. Insert the details of the users who register with the web site, whenever a new user clicks the submit button in the registration page	1, 2, 3	a, b, e, k, l
7	User authentication is very common in modern web application. It is a security mechanism that is used to restrict unauthorized access to member-only areas and tools on a site. In this context, write a program to create a simple registration and login system using the PHP and MySQL and validate the user's authenticity	2, 3	a, b, e, k, l
8	Create tables in the database which contain the details of items (books in our case like Book name, Price, Quantity, Amount) of each category. Modify your catalogue page (week 2) in such a way that you should connect to the database and extract data from the tables and display them in the catalogue page using PHP	3, 4	a, b, e, k, l

9	The user may add some items to cart from the catalogue page. He can check the cart page for the selected items. He may visit the catalogue again and select some more items. Here our interest is the selected items should be added to the old cart rather than a new cart. Multiple users can do the same WEB TECHNOLOGIES LAB MANUAL jdirectory jkmaterialz jkd thing at a time (i.e., from different systems in the LAN using the IP-address instead of local host). This can be achieved through the use of sessions. Every user will have his own session which will be created after his successful login to the website. When the user logs out his session should get invalidated, modify your catalogue and cart	1, 2, 3	a, b, e, k, l
	PHP pages to achieve the above mentioned functionality using sessions		
10	Create appropriate web page for the following self-descriptive user friendly services. E-Visa Processing & Follow Up System	2, 3, 4	a, b, e, k, l

Mapping COs with POs (Program outcomes)

Course Outcomes	Program outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3	2		2
CO2		3	2		2					3	3	
CO3		2	3							2	2	
CO4		2										1

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS3040	Advanced Web Technologies Lab	16 Weeks	HC	4	0	0	4

Course Outcomes:

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

C01. Summarize the fundamentals and advanced concepts in the area of web services.

C02. Design and Develop JavaScript based web based applications.

C03. Develop PHP based web based applications in real world applications

C04. Make use of the web applications and mechanisms to make it more secure.

List of Programs:

Sl. No.	Program	Course Outcome	Program Outcome
1	Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, lines and words in the text entered using an alert message. Words are separated with white space and lines are separated with new line character	1, 2	a, b, e, k, l
2	Write a JavaScript program which takes user input as name, stores it in array and sort them alphabetically and displays it using alert box	1, 2, 3	a, b, d, k, n
3	Exception handling is the process of responding to exceptions when a computer program runs. An exception occurs when an unexpected event happens that requires special processing. create an html page named to demonstrate exception handling in JavaScript	2, 3	a, b, c, k, i
4	Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following. (i). Create a Cookie and add these four user id's and passwords to this Cookie. (ii). Read the user id and passwords entered in the Login form (week1) and	1, 2, 3	a, b, e, k, l

	authenticate with the values (user id and passwords) available in the cookies. If he is a valid user (i.e., user-name and password match) you should welcome him by name (user-name) else you should display "You are not an authenticated user ". Finding Related Forum Posts through Content Similarity over Intention-based Segmentation		
5	JavaScript is mainly designed to add interactivity in the HTML pages. A JavaScript can be executed when an event occurs, like when a user clicks on an HTML element. To execute code when a user clicks on an element, add JavaScript code to an HTML event attribute Simple web application such as calculator, calendar can be developed using JavaScript. Design a scientific calculator using java script	3, 4	a, b, e, k, l
6	Install a database (Mysql or Oracle). Create a table which should contain at least the following fields: name, password, email-id, phone number Write a java program/servlet/JSP to connect to that database and extract data from the tables and display them. Insert the details of the users who register with the web site, whenever a new user clicks the submit button in the registration page	1, 2, 3	a, b, e, k, l
7	User authentication is very common in modern web application. It is a security mechanism that is used to restrict unauthorized access to member-only areas and tools on a site. In this context, write a program to create a simple registration and login system using the PHP and MySQL and validate the user's authenticity	2, 3	a, b, e, k, l
8	Create tables in the database which contain the details of items (books in our case like Book name, Price, Quantity, Amount) of each category. Modify your catalogue page (week 2) in such a way that you should connect to the database and extract data from the tables and display them in the catalogue page using PHP	3, 4	a, b, e, k, l
9	The user may add some items to cart from the catalogue page. He can check the cart page for the selected items. He may visit the catalogue again and select some more items. Here our interest is the selected items should be added to the old cart rather than a new cart. Multiple users can do the same WEB TECHNOLOGIES LAB MANUAL jdirectory jkmaterialz jkd thing at a time (i.e., from different systems in the LAN using the IP-address instead of local host). This can be achieved through the use of sessions. Every user will have his own session which will be created after his successful login to the website. When the user logs out his session should get	1, 2, 3	a, b, e, k, l

	invalidated, modify your catalogue and cart PHP pages to achieve the above mentioned functionality using sessions		
10	Create appropriate web page for the following self-descriptive user friendly services. E-Visa Processing & Follow Up System	2, 3, 4	a, b, e, k, l

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3	2		2
CO2		3	2		2					3	3	
CO3		2	3							2	2	
CO4		2										L

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

Course Code	Course Title	Duration		L	T	P	C
M19CS2010	Cloud Computing	16 Weeks	HC	4	0	0	4

Prerequisites:

Computer Networks

Course Description:

This course begins by first establishing the definition of cloud computing, then describing the various service delivery models of a cloud computing architecture, and the ways in which cloud can be deployed as public, private, hybrid, and community clouds, followed by a much deeper review of the security and privacy issues related to cloud computing environments.

The objective of this course is to:

Discuss basic concepts related to cloud computing technologies

Describe different layers of cloud computing viz. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)

Illustrate the use of various cloud computing mechanisms

Explain cloud security concepts and secure computation in the cloud.

Course Outcomes:

CO1. Outline the concepts related to cloud computing technologies

CO2. Compare and contrast different layers of cloud computing viz. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)

CO3. Develop applications to make use of Cloud management mechanisms

CO4. Apply cloud security schemes to achieve secure computation in the cloud.

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.

Self-learning Component:

Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture in cloud computing.

Recommended Learning Resources (Text books):

Thomas Erl , Ricardo Puttini , Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, PHI, 2013.

Kai Hwang, Geoffrey C. Fox, Jack J Dongarra, “Distributed and Cloud Computing”, MK, 2012.

Recommended Learning Resources (Reference books):

1. Raj Kumar Buyya, Christian Vecchiola, "Mastering Cloud Computing", Kindle edition, 2018.

2. Dharani P. Janakiram, Grid and Cloud Computing, McGraw-Hill 2016.

3. Transactions on Cloud Computing, IEEE.

4. Journal of Cloud Computing -Advances, Systems and Applications, Springer Open.

5. International Journal of Cloud Computing, INDERSCIENCE Publishers.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3	2		2
CO2		3	2		3					3	3	
CO3		2	3		2					2	2	
CO4		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		L	T	P	C
M19TCS2040	Big Data And Analytics	16 Weeks	HC	4	0	0	4

Prerequisites:

Programming with Python, Programming with Java

Course description:

This course is to familiarize the students with most important information technologies used in manipulating, storing, and analyzing big data. The basic tools for statistical analysis, R and Python, and several machine learning algorithms are introduced. The emphasis of the course will be on mastering Spark 2.0 which emerged as the most important big data processing framework. Spark ML (Machine Learning) API and Spark Streaming which allows analysis of data in flight, i.e. in near real time. We will learn about so-called NoSQL storage solutions exemplified by Cassandra for their critical features: speed of reads and writes, and ability to scale to extreme volumes. We will learn about memory resident databases (VoltDB, SciDB) and graph databases (Ne4J). Students will gain the ability to initiate and design highly scalable systems that can accept, store, and analyze large volumes of unstructured data in batch mode and/or real time. Most lectures will be presented using Python examples. Some lectures will use Java and R.

Course Objectives:

The objective of this course is to:

Discuss the fundamentals of Hadoop distributed file system and Big Data Analytics.

Demonstrate Big Data Processing with MapReduce and Batch Analytics with Apache Spark.

Describe the implementation of Real-Time Analytics with Apache spark in real world Applications.

Illustrate the working of Stream Processing and also discuss the fundamentals of Cloud Computing

Course Outcomes:

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

CO 1: Summarize the fundamentals of Hadoop distributed file system and Big Data Analytics

CO 2: Apply Big Data Processing with MapReduce and Batch Analytics with Apache Spark to simple real world

problems.

CO 3: Implement Real-Time Analytics with Apache spark in real world Applications.

CO 4: Develop data models for real world stream processing Applications.

Course Contents:

Unit-1

Introduction to Hadoop: Hadoop distributed file system: High availability, Intra-Data Node balancer, EC, Port mapping; MapReduce: Task Level optimization; YARN: Opportunistic Containers, Timeline service v.2; Overview of Big data Analytics: Introduction to data analytics, Introduction to big data, distributed computing using Apache Hadoop, MapReduce framework.

Unit-2

Big Data Processing with MapReduce: The MapReduce framework, MapReduce job types: Single mapper jobs, Single mapper reducer jobs, Multiple mappers reducer jobs; MapReduce patterns: Aggregation patterns, Filtering patterns, Join patterns.

Batch Analytics with Apache Spark: SparkSQL and Data Frames, Data Frames and the SQL API, Data Frame schema, Datasets and encoders, loading and saving data, Aggregations and Joins.

Unit-3

Real-Time Analytics with Apache Spark: A short introduction to streaming: At-least-once processing, At-most-once processing, Exactly-once Processing; Spark Streaming: Streaming context, creating streaming context, Starting and Stopping Streaming Context; Discretized Streams, Stateful and stateless transformations, CheckPointing.

Batch Analytics with Apache Flink: Introduction to Apache Flink.

Unit-4

Stream Processing with Apache Flink : Data processing using the DataStream API transformations, Aggregations ,Window , Physical partitioning , Rescaling , Data sinks , Event time and watermarks.

Introduction to Cloud Computing: Cloud computing basics, Concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries, Cloud characteristics, Cloud delivery models, Cloud deployment models.

Self-learning Component:

Concept of AWS and its Services.

Recommended Learning Resources (Text books):

1. Sridhar Alla, Big Data Analytics with Hadoop 3, published by Packt Publishing Ltd, May 2018

2. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, published by wiley india pvt ltd, April 2015.

Recommended Learning Resources (Reference books):

1. Deka, Ganesh Chandra_ Mazumder, Sourav_ Singh Bhadoria, Robin - Distributed Computing in Big Data Analytics - Concepts, Technologies and Applications (Springer International Publishing AG 2017)

2. Arthur Zhang - Data Analytics_ Practical Guide to Leveraging the Power of Algorithms, Data Science, Data Mining, Statistics, Big Data, and Predictive Analysis to Improve Business, Work, and Life.

3. ACM Transactions on Knowledge Discovery in Data (TKDD).

4. SIGKDD Explorations, a magazine of the SIGKDD, the data miners professional group.

5. Data Mining and Knowledge Discovery journal (now published by Springer).

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3			3
CO2	2			1	3				2			2
CO3		3										
CO4		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		L	T	P	C
M19TCS2030	Agile Software Development	**16 Weeks**	**HC**	**3**	**0**	**1**	**4**

Prerequisites:

Basic knowledge of software development process and software development methodologies.

Course Description:

The objective of the course will help you gain knowledge on what is agile? Why agile is better suited for the situations and to cover some of the most common agile frameworks like scrum and XP in depth. The course also examines Agile Development concepts, its evolution from the Waterfall Lifecycle, various agile methods and best practices and knowledge on how to apply Agile to your software projects.

Course Objectives:

The objective of this course is to:

Explain the basics of Agile Software Development and Software Development Rhythms.

Demonstrate the unique features related to traditional agile software practices.

Describe the core principles of a DevOps implementation and culture.

Discuss the enormous benefits of DevOps practices and culture.

Course Outcomes:

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

CO1: Develop applications using traditional Agile Software practices

CO2: Outline the fundamental principles and practices of Agile Software in real world problem

CO3: Analyze the agile principles and values to a given situation.

CO4: Make use of Building Blocks of DevOps methods in real world problems.

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

Self-learning Component:

A Qualitative Study of DevOps Usage in Practices, A Case Study of DevOps at Netflix.

Recommended Learning Resources (Text books):

1. Craig Larman; Agile and Iterative Development: A Manager's Guide. Pearson Education; 2006.
2. Jim Highsmith; Agile Project Management: Creating Innovative Products (Agile Software Development) : Addison Wesley; 2009.
3. Robert Cecil Martin; Agile Software Development: Principles, Patterns, and Practices; Prentice Hall PTR, Upper Saddle River, NJ, USA; 2009.

4. Michael Huttermann; DevOps for Developers, Integrate Development and Operations, the Agile Way, Apress Publications. (https://books.google.co.in/).

Recommended Learning Resources (Reference books):

1. Jeff Sutherland: Scrum: A revolutionary approach to building teams, beating deadlines, and boosting productivity; Random House Business Books; 2014.
2. Mitch Lacey; The Scrum Field Guide: Agile Advice for Your First Year; Addison Wesley: 2012.
3. Martin C. Robert, Martin Micah: Agile Principles, Patterns, and Practices in C#: Prentice Hall, 2006.
4. IEEE transactions on Agile Software Development Using Scrum.
5. ACM Transactions on DevOps.

Mapping COs with POs (Program outcomes)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2							1
CO2	3	2	2	2	3							
CO3	3		2	2	1							1
CO4	3	2	2	2	2					1		

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

List of Experiments:

Sl No.	Programs	Course Outcome	Program Outcome
1	JIRA is a project management tool used for issues and bugs tracking system. Show that how the users can utilize this tool to track and report bugs in different applications.	1,2	a,b

2	Chef is a configuration management technology developed by Opscode to manage infrastructure on physical or virtual machines. It is an open source developed using Ruby, which helps in managing complex infrastructure on the fly. Design an application of managing an infrastructure using Chef.	1,2	a,b
3	Mantis is a Bug Reporting tool, widely used as an issue tracking tool for all types of testing. Design an application to show the usage of Mantis and also show that how to utilize the tool in reporting and maintain an issue.	2,3	b,c
4	SaltStack is an open-source configuration management and remote execution engine. Write a code in any language to show that how a SaltStack is accessed remotely and executes commands across all machines.	2,3	c,d
5	Design an application using ansible: It is simple open source ITengine which automates application deployment, intra service orchestration, cloud provisioning and many other IT tools.	3,4	c,d
6	Design an application on how to drive a scrum project, prioritize and organize the backlog prints, run scrum ceremonies and more, all within Jira Software.	4	c,d

Course Code	Course Title	Duration		L	T	P	C
M19CS2031	**Python for TData Analysis**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Object Oriented Programming principles, Programming languages(C, C++, etc.), Database Management Systems Lab (B18CS4060)

Course Description:

Python has become the language of choice for data analytics. One of the major reasons for this is the availability of some easy and fun to work with libraries in python which make it interesting to work and analyze large data sets. Python is really emerging as the leader in Data Science. There's battle out there happening in the minds of aspiring data scientists to choose the best data science tool. Though there are quite a number of data science tools that provide the much-needed option, the close combat narrows down between two popular languages – Python and R.

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Course Objectives:

The objectives of this course are to:

1. Explain the concepts of data and descriptive statistics;
2. Demonstrate the knowledge on python programming and data analysis techniques;
3. Illustrate the use of concepts of Regression, Classification and Clustering;
4. Discuss the NLP and Deep Learning concepts;

Course Outcomes:

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

CO1:Understand the concepts of Python, data structures, functions;

CO2:Make use of inbuilt packages like numPy and pandas to perform operations on dataset

CO3:Experiment with various pre processing techniques for data analysis .

CO4:Apply data wrangling and to plot and visualize data.

Course Contents:

Unit 1

Data Definition: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing, Introduction to statistical learning and Python Programming.

Descriptive Statistics: Measures of central tendency, Measures of location of dispersions, Practice and analysis with Python

Unit- 2
Python Programming Module: Introduction, Data structures in python, Functions and modules, OOP concepts, regular expressions, File Operations, Data Analytics Module
Basic Analysis Techniques: Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance Correlation analysis, Maximum likelihood test, Practice and analysis with Python

Unit- 3
Regression Algorithms: Ordinary Least Squares, Lasso, Ridge, Bayesian
Classification Algorithms: Logistic, Decision Tree, kNN, Naive bayes, SVM, Random Forest, Ensemble models – Bagging and Boosting
Clustering Algorithms: K-means, DBSCAN, Hierarchical, Agglomerative, Spatial

Unit- 4

Natural Language Processing: Bag-of-words model and algorithms for NLP. Machine Learning with stats models and scikit-learn, Deep learning with TensorFlow.

Artificial Neural Networks, Convolutional Neural Networks, Dimensionality Reduction using PCA, LDA, Kernel PCA.

Recommended Learning Resources (Text Books)

1. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython by Wes McKinny, O'Reilly Media, 2012. ISBN 978-1-4493-1979-3

2. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705.

Recommended Learning Resources (Reference Books)

1. Inderscience Journal of Data Mining , Modelling and Management

2. ACM Transactions on Knowledge Discovery from Data (TKDD)

3. ACM Transactions on data Science (TDS)

4. IEEE Transactions on Knowledge and Data Engineering

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes												
	a	b	c	d	e	f	g	i	j	k	l	m	n
CO1										3	2		
CO2			3		2					3	2		1
CO3				3	1						3	2	2
CO4		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		L	T	P	C
M19TCS2032	**Parallel Computing and Programming**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Data Structures (BTCS15F3200), Operating Systems (BTCS15F5100) and C/ C++ programming (BTCS15F5200) language.

Course Description:

Paradigms for the development of sequential algorithms, such as divide-and-conquer and the greedy method, are well known. Paradigms for the development of parallel algorithms, especially algorithms for non-shared memory MIMD machines, are not well known. These paradigms are important, not only as tools for the development of new algorithms, but also because algorithms using the same paradigm often have common properties that can be exploited by operations such as contraction.

Course Objectives:

The objectives of this course are to:

The objectives of the course are to:

Explain the basic theory underlying parallel computing.

Demonstrate the use of One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reductions in developing parallel programming.

Illustrate the use of Open MPI operations in developing Parallel programs.

Discuss the concepts ofo POSIX threads.

Course Outcomes (Cos):

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

CO1: Identify the type of parallelism required for solving the given problem

CO2: Apply basic communication operations for solving the given real world problem.

CO3: Develop parallel programs using message passing technique to solve the real world problems.

CO4: Build the programs using shared memory inter process communication for solving real world problems

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,

Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction

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: Principles of Messaging- Passing Programming, The Building blocks: Send and Receive Operations, MPL, Topologies and Embedding, Overlapping communication with Computation.

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.

Self-learning Component

Shared Memory, Messaging passing, OpenMP, CUDA.

Recommended Learning Resources(Text Books):

1. Ananth Grama, George Karypis, Vipin Kumar, and Anshul Gupta : Introduction to Parallel Computing, Pearson , Second Edition, 2016

2. Michael J. Quinn. , Parallel programming in C with MPI and OPENMP by, McGraw Hill Education.

Recommended Learning Resources (Reference books):

1. Peter S. Pacheco , An Introduction to Parallel Programming by., Morgan Kaufmann Publishers(MK).

2. Parallel Computing – Elsevier

3. International Journal of Parallel Programming – Springer

4. International Journal of Parallel Programming - ACM Digital Library.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1		3			1
CO2	3	1	2	1	2				2			1
CO3	3	2	2	1	2	1	1		3			
CO4	3	2	2	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		L	T	P	C
M19TCS2043	Open Source Cloud Computing Tools	16 Weeks	SC	4	0	0	4

Prerequisites:

Cloud Computing, Network Basics

Course Description:

This course in open source cloud computing tools provides an insight in to designing and creating an architecture for first nontrivial OpenStack cloud. Illustrates how to organize computer, networking, and storage resources and the associated software packages. Perform the day-to-day tasks required to administer a cloud.

Course Objectives:

The main objectives of this course are:

1. Discuss the basics of OpenStack Networking
2. Explain the OpenStack architecture
3. Demonstrate the design of a network.
4. Illustrate User-Facing Operations suitable to use-cases of OpenStack

Course Outcomes:

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

CO1: Experiment with operations of the OpenStack Networking.

CO2: Analyze the working of OpenStack architecture.

CO3: Design a network for a real world problem.

CO4: Create OpenStack for user-enabling processes to manage users

Course Contents:

Unit- 1

OpenStack Networking: Overview; Detailed Description; Example Component Configuration; Provisioning and Deployment: Automated Deployment; Disk Partitioning and RAID; Network Configuration; Automated

Configuration; Remote Management; Designing for Cloud Controllers and Cloud Management: Hardware Considerations; Separation of Services; Database; Message Queue; Conductor Services; Application Programming Interface (API); Extensions; Scheduling; Images; Dashboard; Authentication and Authorization; Network Considerations

Unit -2

Compute Nodes: Choosing a CPU; Choosing a Hypervisor; Instance Storage Solutions; Off Compute Node Storage—Shared File System; On Compute Node Storage—Shared File System; On Compute Node Storage—Nonshared File System; Issues with Live Migration; Choice of File System; Overcommitting; Logging; Networking; Scaling: The Starting Point; Adding Cloud Controller Nodes; Segregating Your Cloud; Cells and Regions; Availability Zones and Host Aggregates; Scalable Hardware; Hardware Procurement; Capacity Planning; Burn-in Testing; Storage Decisions: Ephemeral Storage; Persistent Storage; Object Storage; Block Storage; OpenStack Storage Concepts; Choosing Storage Backends; Commodity Storage Backend Technologies

Unit- 3

Network Design: Management Network; Public Addressing Options; IP Address Planning; Network Topology; Services for Networking; Operations: Using the OpenStack Dashboard for Administration; Command-Line Tools; Network Inspection; Users and Projects; Running Instances; Managing Projects and Users: Projects or Tenants; Managing Projects; Quotas; User Management; Associating Users with Projects

Unit- 4

User-Facing Operations: Images; Adding Images; Sharing Images Between Projects; Deleting Images; Other CLI Options; The Image Service and the Database; Example Image Service Database Queries; Flavors; Private Flavors; How Do I Modify an Existing Flavor; Security Groups; General Security Groups Configuration; End-User Configuration of Security Groups; Block Storage; Block Storage Creation Failures; Instances; Starting Instances; Instance Boot Failures; Using Instance-Specific Data; Associating Security Groups; Floating IPs; Attaching Block Storage; Taking Snapshots; Live Snapshots; Instances in the Database;

Self-learning Component:

Maintenance, Failures, and Debugging; Network Troubleshooting; Logging and Monitoring; Backup and Recovery; Customization; Upstream OpenStack; Advanced Configuration.

Recommended Learning Resources (Text books):

1. Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, OpenStack Operations Guide, O'Reilly Media, Inc, 2014.

Recommended Learning Resources (Reference books):

1. Kevin Jackson, Cody Bunch, OpenStack Cloud Computing Cookbook, Second Edition, Packt Publishing, 2013.
2. Dan Radez, OpenStack Essentials, Packt Publishing, 2015.
3. www.openstack.org
4. www.redhat.com/Private_Cloud/OpenStack

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	3							3						
CO2			2	2								2		
CO3			3			3			3		3			
CO4			3	3										

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS2051	Unix Operating System & Internals	16 Weeks	SC	4	0	0	4

Prerequisites:

Program for problem solving, Operating Systems (BTCSF5100)

Course Description:

This course gives introduction of hierarchical structure, principles, algorithms, application, development and management of UNIX operating system multi-dimensionally, systematically and from the elementary to profound. It gives a deeper understanding of how UNIX operating system functions.

Course Objectives:

The objectives of this course are to:

Explain the history, basics and structure of UNIX Operating System

Demonstrate the different states of UNIX process and scheduling techniques

Discuss UNIX memory management techniques

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:

CO1: Summarize the history, basics and structure of UNIX operating systems.

CO2: Make use of various UNIX process management and scheduling schemes

CO3: Design applications using memory management techniques

CO4: Explore the internals of UNIX operating system

.

Course Contents:

Unit-1

Background of UNIX Operating System: Introduction of Operating System, Types of UNIX, History of UNIX, UNIX Software Architecture: System Call Interface, Standard Libraries and Language Libraries, UNIX Shell, Applications, UNIX Environment, Character User Interface Versus Graphical User Interface, UNIX Command Lines.

Unit-2

UNIX Process Management: Multiple Processes Running Concurrently: Fundamental Concept for Scheduler and Scheduling Algorithm, UNIX Scheduling Algorithm and Context Switch, Process States, Process Image and Attributes, Process Control: Running Command in Foreground or in Background, More Concepts about Process Concurrently, Execution in UNIX, UNIX Inter-Process Communication, UNIX Signals, Termination of Processes, Daemons UNIX Background "Guardian Spirits", UNIX System Boot and Init Process.

Unit-3

UNIX Memory Management: Outline of Memory Management: Memory Allocation Algorithms in Swapping, Page Replacement Algorithms in Demand Paging, Process Swapping in UNIX: Swapped Content, Timing of Swapping, Allocation Algorithm, Selection Principle of Swapped Processes, Swapper, Swapping Effect, Demand Paging in UNIX: Demand Paging, Page Replacement.

Unit-4

UNIX File System: UNIX File System Structure: File System Organization, Home and Working Directories, Absolute and Relative Pathnames, UNIX Inodes and Data Structures for File System, UNIX File Concept and Types of Files, Managing Files and Directories : Displaying Pathname for Home Directory and Changing Directories, Viewing Directories and File Attributes, Creating Directories and Files, Displaying Type of a File, File and Directory Wildcards, UNIX File Storage and File System Implementation.

Self-Learning Component:

The text editor - vi editor with modes and gedit, UNIX shell introduction, UNIX I/O system, I/O redirection and piping, Programming using Bourne shell.

Recommended Learning Resources (Text books)

Yukun Liu,Yong Yue ,Liwei Guo ; UNIX Operating System: The Development Tutorial via UNIX Kernel Services ; Springer, Higher Education Press, 2011.

Maurice J. Bach ; The Design of the UNIX Operating System; Pearson Education; Prentice Hall of India, 2004.

Recommended Learning Resources (Reference books)

1. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall of India, seventh edition 2011.
2. D. M. Dhamdhere; Operating Systems: A Concept-Based Approach; Tata McGraw-Hill,2002.
3. Gary J. Nutt; Operating Systems: A Modern Perspective; Addison-Wesley, 2011.
4. Springer Transaction for advance in Distributed computing and middleware.
5. IEEE Transaction for Real time operating system.
6. ACM Transaction for embedded operating system.

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes(USP)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	3	3	2	0	0	0	0	0	0	0
CO 2	2	3	3	3	2	0	0	0	0	0	0	0
CO 3	2	3	3	3	2	0	0	0	0	0	0	0
CO 4	2	3	3	3	2	0	0	0	0	0	0	0

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS4021	Program Analysis	16 Weeks	SC	4	0	0	4

Prerequisites:

Data Structures Using C, Analysis and Design of Algorithms

Course Description:

Data flow analysis in a program is used to discover information for a wide variety of useful applications, ranging from compiler optimizations to software engineering and verification. Modern compilers apply it to produce performance-maximizing code, and software engineers use it to re-engineer or reverse engineer programs and verify the integrity of their programs. The course will mainly cover topics: Introduction, compiler architecture, intermediate representations, Dataflow analysis, Control flow analysis, control-flow graphs, basic blocks, Pointer and alias analysis, Interprocedural analysis, Advanced Topics: Program Synthesis, Program Testing, & Types and Programming.

Course Objectives:

The objective of this course is to:

1.Explain the basic concepts of data flow analysis through a contemporary optimization.

2.Describe common properties of program analysis at an abstract level.

3. Discuss the Complexity of Iterative Data Flow Analysis.

4. Illustrate the Data Flow Analysis in GCC

Course Outcomes:

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

CO1: Summarize the basic concepts of data flow analysis and common properties of variables and expressions.

CO2: Apply graph properties to data flow analysis, framework, assignments, functions and equations.

CO3: Design data flow analysis algorithm in round robin and iterative methods.

CO4: Develop various data flow analysis algorithms using the concept of GCC.

Unit-1

An Introduction to Data Flow Analysis : A Motivating Example, Program Analysis: The Larger Perspective, Characteristics of Data Flow Analysis, Classical Bit Vector Data Flow Analysis: Basic Concepts and Notations, Discovering Local Data Flow Information, Discovering Global Properties of Variables, Discovering Global Properties of Expressions.

Unit-2

Theoretical Abstractions in Data Flow Analysis: Graph Properties Relevant to Data Flow Analysis, Data Flow Framework, Data Flow Assignments, Computing Data Flow Assignments, General Data Flow Frameworks: Non-Separable Flow Functions, Discovering Properties of Variables.

Unit-3

Complexity of Iterative Data Flow Analysis: Generic Flow Functions and Data Flow Equations, Generic Round-Robin Iterative Algorithm, Complexity of Round-Robin Iterative Algorithm

Unit 4

An Introduction to GCC: About GCC, Building GCC, Implementing Data Flow Analysis in GCC : Specifying a Data Flow Analysis, An Example of Data Flow Analysis

Self-learning Component:

Discovering Properties of Pointers, Liveness Analysis of Heap Data, Implementing the Generic Data Flow Analyzer gdfa.

Recommended Learning Resources (Text books):

1. Uday P. Khedker, Amitabha Sanyal, and Bageshri Karkare. Data Flow Analysis: Theory and Practice. CRC Press, USA (2009).

Recommended Learning Resources (Reference books):

1. M. S. Hecht. Flow Analysis of Computer Programs. ElsevierNorth-Holland Inc. 1977.
2. F. Nielson, H. R. Nielson, and C. Hankin. Principles of Program Analysis Springer-Verlag. 1998.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	3	2	3	3	1	1	3
CO2	3	3	2	1	3	3	2	3	3	1	2	3
CO3	3	3	3	3	3	3	3	1	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	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		L	T	P	C
M19TCS023	User Interface (UI)/ U4ser Experience (UX) Design	16 Weeks	SC	4	0	0	4

Prerequisites:

Data Structures Using C, Analysis and Design of Algorithms

Course description:

This course aims at providing knowledge of basic concepts of UI and UX. UX design refers to user experience design, while UI design stands for user interface design. Both of these are crucial to an IT product and need to work closely together. Despite being very integral to each other, the roles themselves are quite different, involving distinct processes.

Course Objectives:

The objectives of this course are to:

1. Explain the new technologies that provide interactive devices and interfaces.
2. Illustrate the UI/UX design process.
3. Describe various Interaction styles including Direct Manipulation and Virtual Environment
4. Discuss the command, natural languages and issues in design for maintaining QoS.

Course Outcomes:

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

CO1: Understand the new technologies that provide interactive devices and interfaces in real world applications

CO2:Implement the UI/UX design process and evaluate UID.

CO3:Develop applications using various Interaction styles including Direct Manipulation and Virtual Environment..

CO4:Elaborate the command, natural languages and issues in design for maintaining QoS.

Course Contents:

Unit- 1

Introduction: Usability of Interactive Systems: Introduction, Usability Goals and Measures, Usability Motivation, Universal Usability, Goals for our profession. Guideline, principles, and theories: Introduction, Guidelines, principles, Theories.

Unit -2

Development Process: Managing Design Processes- Introduction, Organizational Design to support Usability, The Four Pillars of Design, and Development methodologies: Ethnographic Observation, Participatory Design, Scenario Development, and Social Impact statement for Early Design Review, Legal Issues.

Evaluating Interface Design- Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance tests, Evaluation during Active Use, Controlled Psychologically Oriented Experiments

Unit- 3

Interaction Styles: Direct Manipulation and Virtual Environments- Introduction, Examples of Direct Manipulation, Discussion of direct manipulation, 3D Interfaces, Tele-operation, Virtual and Augmented Reality.

Menu Selection, Form Filling and Dialog Boxes- Introduction, Task-Related Menu Organization, Single Menus, Combination of Multiple Menus, Content Organization, Fast Movement Through Menus, Data Entry With Menus, Form Filling, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays.

Command and Natural Languages- Introduction, Command-organization functionality strategies and structure, Naming and Abbreviations, Natural Language in computing.

Interaction Devices- Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory interfaces, Displays-Small and Large

Unit- 4

Design Issues: Quality of Service- Introduction, Models of Response-Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response time, Frustrating Experiences Balancing Function and Fashion: Introduction, Error Messages, Nonanthropomorphic Design, Display design, web page design, Window Design, Colour User Documentation and Online Help- Introduction, Online versus paper documentation, Reading from paper versus Displays, Shaping the content of the Manuals, Accessing the Documentation, Online Tutorials and animated demonstrations, Online Communities for User Assistance, The Development Process.

Self-Learning Component:

Information Search and Visualization- Introduction, Search in Textual Documents and Database Querying, Multimedia document searches, Advanced filtering and Search Interfaces, Information Visualization: Introduction, Data type by task taxonomy, Challenges for information visualization.

Recommended Learning Resources (Text Books):

1. Ben Shneiderman, Plaisant, Cohen, Jacobs: Designing the User Interface, 5th Edition, Pearson ,Education, 2010.
2. Alan Dix, Janet Finalay, Gregory D AbiwdmRusselBealel: Human-Computer Interaction, III Edition, Pearson , Education, 2008.

Recommended Learning Resources (Reference Books):

1. Eberts: User Interface Design, Prentice Hall, 19944.
2. Wilber O Galitz: The Essential Guide to User Interface Design- An Introduction to GUI Design,
3. Principles and Techniques, Wiley-Dreamtech India Pvt Ltd, 20115

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	1	1					2
CO2	3	2	2	2	1							1
CO3	3	2	2	2	1							2
CO4	3	3	2	2	1							2

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS4031	**Robotic Process Automation**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Basic Programming skills in .Net, VB, C#, JavaScript, HTML, SQL queries, Knowledge of key terminologies (OCR, Process flow, Exception handling, Bots, algorithms)

Course Description:

Robotic Process Automation (RPA) offers many challenges for software developers and scientists. This course introduces the UiPath Robotic Process Automation concepts through UiPath Studio and UiPath Orchestrator where a student gains knowledge of how to build a bot to automate required tasks.

Course Objectives:

The objectives of this course are to:

1. Discuss the concepts of Robotics Process automation
2. Describe the sequence, flowchart and control flow in automation tool
3. Demonstrate the data manipulation techniques
4. Demonstrate the usage of UI Explorer and Screen scraping.

Course Outcomes (CO's):

CO1: Make use of recording features in UiPath Studio to automate the repetitive tasks.

CO2: Apply appropriate Workflow Activities in UiPath Studio to automate the complex tasks using Flowchart and Sequence.

CO3: Build data table and data manipulation techniques in UiPath Studio to automate CSV / Excel workbook applications

CO4: Design and Develop bot process using UI Explorer and Automate using Screen Scraping for applications in UiPath Studio.

Course Contents:

UNIT-1

What Is Robotic Process Automation: Scope and techniques of automation, Robotic process automation, About UiPath, Future of Automation. Record and Play: UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder.

UNIT-2

Sequence. Flowchart and Control Flow: Sequencing the Workflow, Activities, Control Flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control Flow

UNIT-3

Data Manipulation: Variables and Scope, Collections, Arguments-Purpose and use, Data table usage and examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa with a step-by-step example

UNIT-4

Taking Control of the Controls: Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls-mouse and keyboard activities, Working with UI Explorer, Handling events, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR.

Self-learning components

Handling User Events and Assistant Bots

Recommended Reference Books (Text books):

1. Learning Robotic Process Automation Alok mani Tripathi Kindle Edition, Published rch by Packt Publishing, 2018.

2.E. Turban, R. Sharda, D. Delen, David King, Business Intelligence, 2nd ed. Pearson India, 2010.

Recommended Reference Books (Reference books):

1. Marlon Dumas et. al., Fundamentals of Business Process Management, Springer, ebook, 2012.

2. Van der Aalst, Process Mining: Discovery, Conformance and Enhancement of Business Processes, Third

edition, 2011.

Mapping Cos with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2					2		
CO2	3	3	3	3	3					2		
CO3	3	3	3	3	3					2		
CO4	3	3	3	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		L	T	P	C
M19TCS4032	**Block Chain Technology**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Cryptography concepts

Course description:

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This course introduces the concept of digital crypto currencies using Blockchain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way. The course also discuss the concept and applications of Blockchain that have now spread from crypto currencies to various other domains, including business process management, smart contracts, IoT and so on. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from

different application domains.

Course Objectives:

.

The objective of the course is to:

1.Explain the underlying technology of transactions, blocks, proof-of-work, and consensus building

2.Discuss Hyperledger to build applications on blockchain

3. Describe the architecture of bit coins and to give the working of the bit coin

4.Illustrate the design and implementation of new ways of using blockchain technology

Course Outcomes:

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

CO1: Explain the basic architecture and design of a blockchain

CO2: Discuss various aspects of permissioned blockchain - Hyper ledger

CO3: Analyse various use cases of blockchain implementation

CO4: Develop new use cases for blockchain implementation

Course Contents:

Unit-1

Introduction to Blockchain: History: Digital Money to Distributed Ledgers; Design Primitives: Protocols, Security, Consensus, Permissions, Privacy; Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature; Hashchain to Blockchain; Basic consensus mechanisms; Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain Consensus, consensus protocols.

Unit-2

Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains Hyperledger Fabric I: Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation; Hyperledger Fabric II: Beyond Chaincode: Fabric SDK and Front End Hyperledger composer tool.

Unit-3

Use case I: Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance;

Use case II: Blockchain in trade supply chain: Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc

Use case III: Blockchain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system, social welfare systems.

Unit-4

Blockchain Cryptography, Privacy and Security on Blockchain; Research aspects I: Scalability of Blockchain consensus protocols, Case Study of various recent works on scalability;

Research aspects II: Secure cryptographic protocols on Blockchain; Case Study of Secured Multi-party Computation,

Blockchain for science: making better use of the data-mining network; Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more.

Self-learning Component:

Explore the architecture and design of Ethereum,

Recommended Learning Resources (Text books):

1. Bitcoin and Cryptocurrency Technologies by Arvind Narayanan, Joseph Bonneau, Edward Felten,
2. Andrew Miller, and Steven Goldfeder, Princeton University Press,2016

3. Mastering Bitcoin by Andreas Antonopoulos
4. https://github.com/bitcoinbook/bitcoinbook

Recommended Learning Resources (Reference books):

1. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
2. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
3. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
4. http://cs251crypto.stanford.edu/18au-cs251/syllabus.html

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	L	L	L	3	-	-	-	-	-	-	-
CO2	2	2	2	2	3	-	-	-	-	-	-	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-
CO4	3	3	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		L	T	P	C
M19TCS4033	**Deep Learning**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Machine Learning for Data Analytics (B18CS6010)

Course Description:

This course introduces to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task. Deep learning is behind many recent advances in AI, including Siri's speech recognition, Facebook's tag suggestions and self-driving cars.

Course Objectives:

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

The objectives of this course are to:

1.Apply a Mathematical model for a real world application.

2.Explain suitable learning algorithm for a real world application.

3. Design a deep learning neural network for a real world application.

4. Demonstrate the deep learning techniques in neural networks and natural language processing.

Course Outcomes:

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

CO1. Apply the basic concepts of mathematics to solve problems based on deep learning concepts.

CO2. Make use of suitable machine learning algorithms on real world problems (classification, clustering).

CO3. Utilize deep learning neural network model on real time applications like(face recognition, speech recognition)

CO4. Adapting CNN concepts on NLP and Recommender systems applications.

Course Contents:

Unit 1

Introduction: Applied math and Machine Learning Basics: Linear Algebra-Scalors, Vectors, Matrices and Tensors, Eigen Decomposition, SVD, PCA Probability and Information Theory-Probability Distribution, Conditional Probability, Chain Rule of Conditional Probability, Bayes' Rule.

Unit- 2

Numerical Computation: Overflow, Underflow, Gradient Based Optimization, Constrained Optimization, Linear Least Squares, Machine Learning Basics- Learning Algorithms, Overfitting and Underfitting, Maximum Likelihood Estimation, Supervised and Unsupervised Learning Algorithms, Building Machine Learning Algorithm, Challenges Motivating Deep Learning

Unit -3

Deep Networks: Modern Practices-Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architectural Design, Back-Propagation Algorithm.

Unit- 4

Convolutional Networks: Recurrent Neural Networks, Applications- Natural Language Processing, Recommender Systems.

Self-Learning Component:

Linear factor Models, Structured probabilistic Models, Monte-Carlo Methods, Deep generative

Models.

Recommended Learning Resources (Text Books)

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." First edition, An MIT

Press book in preparation. (2015).

2. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.

Recommended Learning Resources (Reference Books Books)

1. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.
2. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
3. Springer Journal of Machine Learning.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2					2	2	1	2
CO2	2		1	2	1			1	2		1	2
CO3	1		1	2	2			1	1		1	2
CO4	1	1		2	1				1	1		2

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration		L	T	P	C
M19TCS2040	**Big Data & Analytics Lab**	**16 Weeks**	**HC**	**0**	**0**	**2**	**2**

Course Outcomes (Cos):

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

CO1.Summarize the fundamentals of Hadoop distributed file system and Big Data Analytics.

CO2.Apply and compare basic applications of Big Data Processing with MapReduce and Batch Analytics with Apache Spark.

CO3.Design and Implement Real-Time Analytics Applications.

CO4.Perform analytics and build models for real world stream processing problems.

List of Programs

Sl. No.	Program	Course Outcome	Program Outcome
1	Installing Hadoop 3, Hive, Derby, R, Anaconda, Python, Apache Spark, Apache Flink, Tableu	1, 2	a, b, e, k, l
2	Download any data sets from UCI Machine Learning Repositories or Kaggle. Perform Exploratory data analytics that include: Study of data through pairplots, heatmaps, histograms, finding correlations amongst data, and so on	2, 3	a, b, e, k, l
3	Install R on a shared server and connect to Hadoop. Demonstrate execution of R programming constructs inside MapReduce using RMR2. Hence, develop any application using R and Hadoop Streaming by choosing data sets from Internet-bound big data repositories	1, 2, 3	a, b, e, k, l
4	Perform Machine Learning Clustering Task using SparkML in Python by choosing public datasets that are openly available for the task identified. Then, perform experiments and interpret the results obtained	3, 4	a, b, e, k, l
5	Use Map Reduce framework to perform big data analytics on distributed clusters. by choosing public datasets that are	1, 3, 4	a, b, e, k, l

	openly available for the task identified. Then, perform experiments and interpret the results obtained.		
6	Use Spark framework to perform big data analytics on distributed clusters. by choosing public datasets that are openly available for the task identified. Then, perform experiments and interpret the results obtained.	1, 2, 3	a, b, e, k, l
7	Perform big stream data analytics on using spark framework using SparkML in Python by choosing public datasets that are openly available for the task identified. Then, perform experiments and interpret the results obtained.	3, 4	a, b, e, k, l
8	Perform big stream data analytics on using Flink framework using SparkML in Python by choosing public datasets that are openly available for the task identified. Then, perform experiments and interpret the results obtained.	1, 3, 4	a, b, e, k, l
9	Hadoop requires external memory for processing big data applications, whereas, it suffers from its poor processing time due to this limitation. Apache Spark is found to overcome the limitations of Hadoop by performing in-memory data processing. Develop Batch Analytics application using Apache Spark. Real time-Analytics application using Apache Spark. (Note: choose data sets from Internet-bound big data repositories)	2, 3, 4	a, b, e, k, l
10	Develop any Batch-Analytics application using Apache Flink.	3, 4	a, b, e, k, l

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3			3
CO2	2			L	3				2			2
CO3		3										
CO4		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		L	T	P	C
M19TCS4040	**Cyber Security Lab**	**16 Weeks**	**SC**	**0**	**0**	**2**	**2**

Course Outcomes:

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

CO1: Implement the cipher techniques

CO2: Develop the various security algorithms

CO3: Design different open source tools for network security and analysis

CO4: Demonstrate intrusion detection system using various open tools

List of Programs

Sl. No.	Program	Course Outcome	Program Outcome
1	Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts: a) Caesar Cipher b) Playfair Cipher c) Hill Cipher d) Vigenere Cipher e) Rail fence – row & Column Transformation	1, 2	a, b, e, k, l
2	Implement the following algorithms a) DES b) RSA Algorithm c) Diffiee-Hellman d) MD5 e) SHA-1	1, 2	a, c, e, k, i
3	Implement the Signature Scheme - Digital Signature Standard	2, 3	a, b, c, k, l

4	Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG)	3, 4	a, d, e, i, k
5	Setup a honey pot and monitor the honeypot on network (KF Sensor)	1, 2, 3	a, b, d, k, l
6	Installation of rootkits and study about the variety of options	1, 3, 4	a, b, e, k, l
7	Perform wireless audit on an access point or a router and decrypt WEP and WPA. (Net Stumbler)	2, 3, 4	a, c, e, k, m
8	Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)	1, 2, 3	a, d, e, i, j

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2			2						2		
CO2	2				2				2			
CO3			2	2						2		
CO4	3			2	2					2	2	

Where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO

Course Code	Course Title	Duration		L	T	P	C
M19TCS5011	**Virtual and Augmented Reality**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

Problem Solving with Programming (C/C++), Data Structures, Computer Graphics and Animation.

Course Description:

.

This Course provides the knowledge on Virtual reality concepts, multiple modal interaction, visual-auditory-haptic, interaction inmersion and imagination, visual computation and environmental modeling; geometric behavior and physically based simulation; management of large scale environment, VR development tools, augmented reality, mixed reality, digital entertainment

Course Objectives:

1. Explain the principles and multidisciplinary features of virtual reality.

2. Illustrate the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behavior.

3. Describe the objects using technology for managing large scale VR environment in real time.

4.Demonstrate the design of the solutions using VR system framework and development tools.

Course Outcomes:

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

CO1 Summarize the fundamentals of Augmented Reality and Virtual Reality.

CO2 Apply multimodal user interaction and perception techniques involved in Virtual Reality.

CO3: Design different objects using Simulation and Interactive techniques for real world applications.

CO4: Develop innovative Virtual Reality solutions for industrial and Social relevant applications..

Course Contents:

UNIT- 1

Introduction to Virtual Reality (VR): Fundamental Concept and Components of VR, Primary Features and Present Development on VR.

Multiple Modals of Input and Output Interface in VR: Input – Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus and 3D Scanner. Output – Visual, Auditory, Haptic Devices.

UNIT -2

Visual Computation in VR: Fundamentals of Computer Graphics; Real time rendering technology; Principles of Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display.

Environment Modeling in VR: Geometric Modeling, Behavior Simulation, Physically Based Simulation

UNIT- 3.

Haptic & Force Interaction in Virtual Reality: Concept of haptic interaction; Principles of touch feedback and force feedback; typical structure and principles of touch/force feedback facilities in applications. Interactive Techniques in VR: Body Track, Hand Gesture, 3D Manus, Object Grasp.

Development Tools and Frameworks in VR: Frameworks of Software Development Tools in VR, X3D Standard, Vega, MultiGen, Virtools, Unity.

UNIT- 4

Augmented Reality: System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

Application of VR in Digital Entertainment: VR Technology in Film and TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

Self-learning Component:

Unity 3D, Manus VR

Recommended Learning Resources (Text books):

Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEEPress, 2003/2006.

Recommended Learning Resources (Reference books):

1. Sherman, William R. and Alan B. Craig, Understanding Virtual Reality – Interface,Application, and Design, Morgan Kaufmann, 2002.

2. Fei GAO, Design and Development of Virtual Reality Application System, TsinghuaPress, March 2012.

3. Guangran LIU, Virtual Reality Technology, Tsinghua Press, Jan. 2011.

4. International Journal of Virtual and Augmented Reality (IJVAR).

5. Springer, Virtual Reality.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	3	2	3	3	2	2	3
CO2	3	3	2	2	3	3	2	3	3	2	2	3
CO3	3	3	3	3	3	3	3	2	3	2	3	3
CO4	3	3	3	3	3	3	3	2	3	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		L	T	P	C
M19TCS5012	**Computer Vision**	**16 Weeks**	**SC**	**4**	**0**	**0**	**4**

Prerequisites:

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

Course description:

The course, introduces a number of fundamental concepts in computer vision, expose students to a number of real-world applications that are important to our daily lives. More importantly, students will be guided through a series of well-designed projects such that they will get to implement using few interesting and cutting-edge computer vision algorithms. The course benefit is to apply computer vision algorithms to solve real world problems Computer Vision is one of the fastest growing and most exciting AI disciplines in today's academia and industry. This course is designed to open the doors for students who are interested in learning about the fundamental principles and important applications of computer vision.

Course Objectives:

The objectives of this course are to:

1. Explain the fundamentals of Computer vision

2. Describe different segmentation techniques

3. Illustrate registration and classification of images.

4. Discuss the concepts of object detection in real world problem

Course Outcomes :

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

CO1. Utilize linear filters to enhance the quality of images.

CO2. Develop Segmentation technique to solve real world problems.

CO3. Design and Develop program for registration and classification of images.

CO4. Apply object detection and recognition techniques to solve real world problems.

Course Contents:

UNIT-1

Introduction and overview to computer vision: Introduction :What is computer vision? A brief history ,Image formation: Geometric primitives and transformations, Geometric primitives, 2D transformations ,3D transformations, 3D rotations, 3D to 2D projections, Lens distortions, Photometric image formation, Lighting, Reflectance and shading, The digital camera, Sampling and aliasing, Color, Compression,

UNIT-2

Image processing, Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization

Feature detection and matching , Points and patches, Feature detectors , Feature descriptors, Feature matching, Feature tracking, Edges, Edge detection, Edge linking, Application: Edge editing and enhancement, Lines, Successive approximation, Vanishing points, Hough transforms, Application: Rectangle detection

UNIT-3

Segmentation : Active contours, Snakes, Dynamic snakes and CONDENSATION, Scissors, Level Sets, Application: Contour tracking and rotoscoping, Split and merge, Watershed, Region splitting (divisive clustering), Region merging (agglomerative clustering) , Graph-based segmentation, Probabilistic aggregation, Mean shift and mode finding, Normalized cuts Graph cuts and energy-based methods .

UNIT-4

HIGH-LEVEL VISION

Registration: Registering Rigid Objects, Model-based Vision: Registering Rigid Objects, Registering Deformable Objects .Learning to Classify: Classification, Error, and Loss, Major Classification Strategies, Practical Methods for Building Classifiers, Classifying Images: Building Good Image Features, Classifying Images of Single, Image Classification in Practice

Detecting Objects in Images: The Sliding Window Method, Detecting Deformable Objects, The State of the Art of Object Detection Topics in Object Recognition: What Should Object Recognition Do?

Self-Learning Component:

Implementation of segmentation using different techniques and evaluation of performance between the methods. Implementation of Registration of non rigid objects , Classification using ensemble methods, object detection in images, localization of images, image captioning

Recommended Learning Resources (Text books):

1. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Edition, University of Illinois at Urbana-Champaign Jean Ponce, Ecole Normale Superieure, Paris©2012, Pearson

2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer

3. David Marr, Tomaso A. Poggio, Shimon Ullman "A Computational Investigation into the Human Representation and Processing of Visual Information", , eBook - Amazon.com

Recommended Learning Resources (Reference books):

1. Gary Bradski, Adrian Kaehler, " Learning OpenCV: Computer Vision with the OpenCV Library" Amazon

2. International Journal of Computer Vision, Springer

3. Image and Vision Computing, Elsevier

4. Computer Vision and Image Understanding, Elsevier

5. IEEE Transactions on Image Processing.

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	-	-	-	-	-	-	-
CO2	3	2	2	2	3	-	-	-	-	-	-	-
CO3	3	2	3	3	3	-	-	-	-	-	-	-
CO4	3	2	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		L	T	P	C
M19TCS5013	Data Privacy	16 Weeks	SC	4	0	0	4

Prerequisites:

Cryptography concepts

Course Description:

This course intend to provide students with an understanding of personal data and information, the background and principles of data protection, the consequences of not adhering to applicable laws and regulations, and responsibilities with respect to data protection. The Data Privacy course is available in multiple versions adapted for various industries, regional laws and jurisdictions.

Course Objectives:

The objective of the course is to

1. Discuss the basic concepts of Data Encryption.

2. Explain the underlying technology for Substitution Ciphers and stream ciphers to build applications for data privacy

3. Demonstrate the use of Data hiding techniques in text and images

4.Describe the different essential resource for data privacy

Course Outcomes:

The objective of the course is to

CO1:Summarize the basic concepts of Data Encryption.

CO2. Make use of the underlying technology for Substitution Ciphers and stream ciphers to build applications for data privacy.

CO3. Design the techniques for Data hiding in text and images.

Unit-1

Data Encryption: Monoalphabetic Substitution Ciphers: Letter Distributions, Breaking a Monoalphabetic Cipher, The Pigpen Cipher, Polybius's Monoalphabetic Cipher, Extended Monoalphabetic Ciphers, The Play fair Cipher, and Homophonic Substitution Ciphers. Transposition Ciphers: Simple Examples, Cyclic Notation and

Keys, Transposition by Turning Template, Columnar Transposition Cipher, Double Transposition, A 2-Step ADFGVX Cipher,

Unit-2

Polyalphabetic Substitution Ciphers and Stream Ciphers: Self-Reciprocal Ciphers, The Porta Polyalphabetic Cipher, The Beaufort Cipher, The Trithemius Cipher ,The Vigen`ere Cipher , Breaking the Vigen`ere Cipher , Long Keys , A Variation on Vigen`ere, The Gronsfeld Cipher , Generating Permutations , The Eyraud Cipher, The Hill Cipher,. Symmetric Key and Public Key, Stream Ciphers , Linear Shift Registers, Cellular Automata, Nonlinear Shift Registers , , Dynamic Substitution, SEAL Stream Cipher , RC4 Stream Cipher Index of Coincidence.

Unit-3

Data Hiding: Data Hiding in Text, Basic Features, Applications of Data Hiding, Watermarking, Intuitive Methods , Simple Digital Methods , Data Hiding in Text, Innocuous Text, Mimic Functions. Data Hiding in Images; LSB Encoding, BPCS Steganography, Lossless Data Hiding , Spread Spectrum Steganography, Data Hiding by Quantization , Patchwork, Signature Casting in Images , Transform Domain Methods , Robust Data Hiding in JPEG Images , Robust Frequency Domain Watermarking , Detecting Malicious Tampering.

Unit-4

Essential Resources: Convolution, One-Dimensional Convolution, Two-Dimensional Convolution , Hashing, Hash Tables, Hash Functions, Collision Handling, Secure Hash Functions, Cyclic Redundancy Codes, Galois Fields, Field Definitions and Operations, GF(256) and Rijndael, Polynomial Arithmetic.

Self-learning Component:

Explore Block Ciphers, Data Hiding in MPEG-2 Video and Stenographic File System

Recommended Learning Resources (Text books):

1. Data Security and privacy by Saloman D, Springer 2013,XIV,465P,45illus,ISBN:978-0-387-00311-

Recommended Learning Resources (Reference books):

1. New Jersey Law against Discrimination. https://ods.rutgers.edu..
2. Rutgers Health Services – Newark: http://health.newark.rutgers.edu/.

Mapping COs with POs (Program outcomes):

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	3	2							
CO 2	3	3	3	3	3							
CO 3	3	3	2	2	2							
CO 4	3	3	2	3	3							

where, L (Low), M (Medium) and H (High) represents strength of correlation between CO and PO.

Course Code	Course Title	Duration		L	T	P	C
M19CS3020	Introduction to Machine Learning	16 Weeks	OE	4	0	0	4

Prerequisites:

Data Structure, Algorithms and Mathematics (Linear Algebra and statistics)

Course Description:

The course introduces machine learning, with various aspects involved in machine learning, types of learning like supervised, unsupervised and reinforcement learning. It also introduces various methods of dimensionality reduction, reasons for dimensionality reduction, concepts of neural networks, different aspects involved in neural networks, their activation function, back propagation algorithm etc

Course objectives:

The objectives of this course are to:

1. Discuss the basic concepts 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. Demonstrate the knowledge of deep learning, a powerful set of techniques for learning in Neural Networks.

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

CO1:Identify the areas for designing a learning system.

CO2:Apply machine learning techniques for solving real world problems.

CO3:Utilize machine learning techniques for solving real world problems.

CO4:Analyse different feature reduction and representation techniques

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

Self-learning Component

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

Recommended Learning Resources (Text Books):

1. Machine Learning Tom Mitchell: McGraw-Hill, McGraw-Hill Education (India) Private Limited, 2013.

2. Introduction to Machine Learning Ethem Alpaydin: Second edition MIT press, 2016

3. Deep Learning -Ian Good fellow, Yoshua Bengio and Aaron Courville.An MIT Press book, 2013

Recommended Learning Resources (Reference Books):

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W

Hsieh, Cambridge Univ Press.

2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley &

Sons Inc., 2001

3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

Mapping COs with POs (Program outcomes)

Course Outcomes	Program Outcomes												
	P01	P02	P03	P04	P05	P06	P07	P08	P08	P09	P10	P11	P12
CO1	3	3	2	2	2								
CO2	2	3	3	3	3								
CO3	2	3	3	3	3								
CO4	L	L	2	L	2								

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

Course Code	Course Title	Duration		L	T	P	C
M19TCS3030	**Project Work Phase – I**	**16 Weeks**	**HC**	**0**	**0**	**4**	**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.

Course Code	Course Title	Duration	Course	L	T	P	C	Hrs/
M19TCS3040	Internship	16	HC	0	0	4	4	4

Experience is becoming a crucial factor for employers when deciding who gets their foot in the door. It's strongly advised that students and graduates take the opportunity to complete a period of work experience to ensure they have a competitive advantage over their peers; and that's where an internship can make all the difference.

An internship is a period of work experience offered by an employer to give students and graduates exposure to the working environment, often within a specific industry, which relates to their field of study. Internships can be as short as a week or as long as 12 months. They can be paid or voluntary; however, before you start an internship it's important to know your rights with regards to getting paid.

Internships can be done in a range of sectors, including sales, marketing, engineering, graphic design, management, I.T. and many, many more. Throughout an internship you will develop a variety of soft skills, including communication skills, personal effectiveness, presentation skills, creative problem solving and influencing skills.

'On-the-job' experience can be as valuable as anything learned in your studies. After all, you cannot really understand what a job is all about until you have worked in that environment. Internships are great opportunities to speak directly to people who have experience in the role you aspire to; and their knowledge of the job and working environment will give you a greater understanding of what it's all about and what you need to do to progress.

Course Code	Course Title	Duration	Course	L	T	P	C	Hrs/
M19TCS3050	Global Certification	16	HC	0	0	4	4	4

Information technology is a highly dynamic and ever-changing field. As the industry evolves, new types or sets of certifications continue to crop up. Getting certified is a surefire way to advance your career in the IT industry. Whether you work for an enterprise, a small business, government, healthcare or any other place that employs IT professionals, your best bet for career advancement is to validate your skills and knowledge through a carefully chosen combination of certifications.

Certification training can help you cover new areas while also reinforcing the skills you already have. Think of it as a refresher course that can help you identify and overcome your problem areas. Certifications do more than just validate your skills and experience. It also shows potential employers that you are committed to the IT field by spending the money and time to obtain your certifications. IT certifications also make career advancement more likely. The plain truth is that, in general, IT certifications can help you get a pay raise or a promotion.

Course Code	Course Title	Duration	Course	L	T	P	C	Hrs/
S20CS3060	MOOC	16	HC	0	0	4	4	4

A MOOC is a model of educational delivery that is, to varying degrees, massive, open, online, and a course. Most MOOCs are structured similar to traditional online higher education courses in which students watch lectures, read assigned material, participate in online discussions and forums, and complete quizzes and tests on the course material.

MOOCs are typically provided by higher education institutions, often in partnership with "organizers" such as Coursera, edX, and Udacity, though some MOOCs are being offered directly by a college or university.

MOOCs arise from the confluence of several important trends, and they raise important questions and spark essential conversations about curriculum design, accreditation, what constitutes a valid learning experience, and who has access to higher education.

The global certifications / MOOCs chosen by the students for their final semester should be considered with the following aspects in mind by the guide.

The certification must be provided from an online source which offers the complete technical course required for the students such as Udacity, Udemy, Coursera, NPTEL, EDX or training provided by Harvard or MIT Online Courses.

The guides must make sure that the certification chosen is technical in nature and is useful for the student in gaining further career opportunities.

The guides must make sure that the certification courses must be of a minimum time per course of 30 hours which makes it equivalent to a subject chosen.

The guides must ensure to inform the students that the certification will be followed by a mini project session where the student must perform a mini-project based on the technical concept learnt (Such as python or data science or Android development).

Provision of the completion certificate is compulsory with the proof of grading, hours of content and the online certificate verification link to verify that the student has not forged the same.

Two internal tests (Assessment in terms of presentation + live demo of technical content learned) must be conducted for the dates further specified.

The guides must make sure that the certifications must be done between January and April 2019. The certifications done before January 10 will not be considered for the same.

Course Code	Course Title	Duration	Course	L	T	P	C	Hrs/
M19DS3070	Sports, Yoga, Music, Dance, Theatre	16	RULO	0	0	2	2	4

Note: Music, Dance, and Theater courses are offered by the School of Performing Arts, whereas the Sports and Yoga courses are offered by the Department of Physical Education. The students have to choose any ONE of these courses.

YOGA FOR HEALTH

Course Objectives:

Following are the Course Objectives.

To prepare the students for the integration of their physical, mental and spiritual faculties;

To enable the students to maintain good health;

To practice mental hygiene and to attain higher level of consciousness;

To possess emotional stability, self-control and concentration; and

To inculcate among students self-discipline, moral and ethical values.

Course Outcomes:

On completion of the course learners will be able to:

Practice yoga for strength, flexibility, and relaxation.

Learn techniques for increasing concentration and decreasing anxiety.

Become self-disciplined and self-controlled

Improve physical fitness and perform better in studies

Gain self-confidence to face the challenges in the society with commitment to serve the society

Course Contents:

Unit-I:

Yoga: Introduction , Surya Namaskara:- 12 counts.

Unit-II:

Asanas: Sitting- Vajrasana, Dandasana, Padmasana, Matsyasana, Paschimottasana, Shirasasana. Asanas: Standing- Tadasana, Trikonasana, Parshwa konasana, Veerabadrasana.

Unit-III:

Asanas: Prone Position- Bhujangasana, Dhanurasana.

Asanas: Supine Position- Sarvangasana, Halasana. Mudras- Dhyana mudra, , Namaste mudra, Nasika mudra

Unit-IV:

Pranayams:- Anuloma – Viloma, Basthrika, Bhramari.

Dhyana & its types: Competition format, Rules and their interpretations

B. VOLLEYBALL

Course Objectives:

To learn the rules, fundamental skills, and strategies of volleyball

To develop skills in passing, setting, serving, spiking, and blocking.

To learn basic offensive and defensive patterns of play.

To develop a positive attitude towards volleyball as a lifetime sport and to improve physical fitness through participation in volleyball.

Course Outcomes:

On completion of the course learners will be able to:

Learn basic skills and knowledge associated with volleyball.

Apply these skills while playing volleyball and exhibit improved performance

Improve physical fitness and practice positive personal and lifestyle.

Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

Introduction about Volleyball

Players Stance, Receiving and passing

The Volley (Overhead pass), The Dig (Underhand pass), Service Reception

Unit-II

Service- Under Arm Service, Tennis Service, Side Arm Spin Service, Round Arm Service, High spin service, Asian serve / American serve (floating)

Setting the ball- Set for attack, Back set, Jump set

Unit-III

Smash/Spike- Straight smash, Body turn smash, Wrist outward smash, Wrist inward smash

Block- Single block, Double block, Three-man block

Rolls- Overhead pass & back rolling, One hand underhand pass with side rolling, Forward dive

Unit-IV

Attack Combination, Defense Systems, Libero play

Court marking, Rules and their interpretations and Duties of officials

C. BASKETBALL

Course Objectives:

The objectives of this course are to:

To learn the rules, fundamental skills, and strategies of Basketball

To develop technical skills in passing, in ball handling, individual offense, individual defense, rebounding, screen, team offense, team defense and fast break.

To learn basic offensive and defensive strategies of play.

To develop a positive attitude towards Basketball as a lifetime sport and to improve physical fitness through participation in Basketball.

To develop positive understanding and appreciation of the basketball game.

Course Outcomes:

On completion of the course learners will be able to:

Learn basic skills and knowledge associated with basketball.

Apply these skills while playing basketball and exhibit improved performance

Improve physical fitness and practice positive personal and lifestyle.

Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

Basketball: Introduction

Grip; Player stance- Triple threat stance and Ball handling exercises.

Passing (Two hand/one hand)- Chest pass, Bounce Pass, Overhead pass, Underhand pass, Hook Pass, Behind the back pass, Baseball pass, Side arm pass and passing in running.

Receiving-Two Hand receiving, one hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

Unit-II

Dribbling- How to start dribble, How to stop dribble, High / Low dribble with variations

Shooting- Layup shot and its variations, One hand set shot, One hand jump shot, Free throw, Hook shot, Tip-in shot.

Stopping- Stride/Scoot, Pivoting and Faking /Feinting footwork.

Unit-III

Rebounding- Defensive rebound, Offensive rebound, Box out, Rebound Organization.

Individual Defensive- Guarding the man with the ball and without the ball.

Offensive drills, Fast break drills, Team Defense/Offense, Team Tactics

Unit-IV

Court marking, Rules and their interpretations

D.FOOTBALL

Course Objectives:

The objectives of this course are to:

To learn the rules, fundamental skills, and strategies of football.

To develop skills in passing, receiving, controlling the ball, dribbling, shielding, shooting, tackling, beating a defender and heading in football.

To learn basic offensive and defensive patterns of play

To use different parts of the body in utilizing the above skills while playing football

To develop a positive attitude towards football as a lifetime sport and to improve physical fitness through participation in football.

Course Outcomes:

On completion of the course learners will be able to:

CO1.Learn basic skills and knowledge associated with football.

CO2.Apply these skills while playing football and exhibit improved performance

CO3.Use the knowledge and understanding to perform, refine and adapt the above skills and related skills with precision, accuracy, fluency and clarity in any situation.

CO4.Improve physical fitness and practice positive personal and lifestyle.

CO5.Gain an understanding of the value of sports in attaining wellness, maintaining good health and developing spirit of teamwork.

Course Contents:

Unit-I

Football: Introduction

Kicks- Inside kick, Instep kick, Outer instep kick, Lofted kick, Chipping, Volley, Half Volley

Trapping- Trapping rolling the ball, Trapping bouncing ball with sole

Unit-II

Dribbling- With instep and outer instep of the foot.

Heading- From standing, running and jumping.

Feinting- With the lower limb and upper part of the body.

Unit-III

Tackling- Simple tackling, Slide tackling.

Throw-in- Standing and Sliding

Goal Keeping- Collection of balls, Ball clearance, throwing and deflecting.

Unit-IV

Ground marking, Rules and their interpretations.

E. ATHLETICS (TRACK AND FIELD)

Course Objectives:

The objectives of this course are to:

To teach students the skilled techniques in sprints, relay running, hurdles, long jump, high jump, and shot put and practice them.

To develop competence among students in demonstrating all the techniques covered in the course.

To make students understand some of the scientific and empirical principles and their rationale underlying the development of skilled performance.

To inculcate among students the habit of team work and cooperative learning and develop competence in detecting / correcting technique errors.

To develop a positive attitude towards sports in general and athletics in particular and to improve physical fitness through participation in various athletic games / sports activities.

Course Outcomes:

On completion of the course learners will be able to:

Display competencies in executing basic techniques and skills associated with select track and field events.

Develop basic skills and techniques to improve one's running posture and take-off position for different jumps.

Learn regular practice of select track and field events and improve physical fitness

Appreciate track and field events by applying sports science knowledge to explain the execution of the events.

Course Contents:

Unit-I

Athletics: Introduction

Track Events - Steeple Chase, Race Walking, Middle and Long distance races

Race walking - Technique, Faults and Officiating.

Middle and Long distance races – Technique and Training

Unit-II

Jumping Events - High Jump and Triple Jump: Basic Skills and techniques

High Jump - Straddle Roll & Flop Technique, Approach, Take-off, Technique in the air, Clearance over the bar & Landing

Triple Jump – Hop, Step and Jump Technique, Approach, Take-off & Landing

Unit-III

Throwing Events - Discus Throw and Hammer Throw: Basic Skills and techniques

Discus Throw - Standing and Rotatory techniques, Grip, Stance, Rotation Technique, Power stance, Release and Reverse (Follow through)

Hammer Throw - Grip, Swings, Rotation foot work, Release and Follow through

Unit-IV

Rules, Officiating and Marking - Ground / Sector Marking, Interpretation of Rules.

Recommended Learning Resources (Text books):

1. Arthur E. Ellison (ed) (1994). Athletic Training and Sports Medicine.
2. Ballisteros, J.M. (1998). Hurdles Basic Coaching Manual, IAAF.
3. Bosen K.O. (1993). Teaching Athletics Skills and Technique.
4. Bosen K.O. (1990). Study Material on Hurdles for the Regular Course Students.
5. Doherty K. (1995). Track and Field Omni book.
6. Martin, David E. Peter N. Coe (1991). Training Distance Runner.
7. Howard S. (1981). Science of Track and Field Athletics.
8. Briggs Graeme (1987). "Track and field coaching Manual", Australian Track and Field Coaches Association. Rothmans Foundation National Sports Division.
9. I.A.A.F. Level-II (2001). Text Book on Jumping Event.
10. Jarver, Jesse (1987). "The Jumps", Track and Field Coaching Manual Australia.

F. DRAMATICS

Pre-requisites:

Students with background in Theatre Arts/ Keen interest in Dramatics.

Course Objectives:

The objectives of this course are to:

To imbibe the acting skills.

To understand the broader applications of theatre studies in allied arts forms.

To be able to use body language for better communication.

Students shall also be able to understand voice modulation and Navarasas.

Course Outcomes:

On successful completion of this course, students should be able to:

Freely express improvisation in non-verbal communication.

Shall hone good acting skills and be able to emote better.

Be able to put up a theatre act and play a key role.

Be able to differentiate good acting and understand the importance of good lyrics, stage crafting, music, dance, costume and lighting.

Course Contents:

UNIT – 1

Working on Body:Body and its analysis. Understanding physical abilities (Anga, Pratyanga and Upanga). Challenges of the body. Using body as metaphor and language. The class's bodies as a collective, an ensemble, a collaborative team.

UNIT – 2

Sound and Movement:Awareness of creating sound patterns, voice modulations, rhythm in speech and diaologues. Understanding the rhythm and patterns of movements like walking, framing, shaping, primitive and animal movements.

UNIT – 3

Characterization and Improvisation:Observation of people around. Getting into the role and living it. Developing a character from establishment (pace and rhythm). Improvisation techniques of body and mind.

UNIT – 4

Group work and Production:Develop a theme, concept or a play and include all the theatre skills, stage craft, costuming and put up an act. Choosing theme and characters.

Recommended Learning Resources (Text books):

All about Theatre – Off stage – Chris Hogget.

Rangadalli Anataranga – K V Subbanna

The Indian Theatre – Hemendranath Das Gupta.

A Practical handbook for an Actor – Milisa Bruder, ee Milchel Cohn, Madeleine Oliek et al, Zigler Publisher.

G.INDIAN CLASSICAL DANCE FORMS (Bharatanatyam, Kuchipudi ,Mohiniyattam)

Prerequisites:

Background of classical dance training or any other dance forms.

Note: Non-classical dancers can also join.

Course Objectives:

The objectives of this course are to:

To develop an understanding about the Indian classical dance forms and its universal application.

To be able to understand the fine nuances of Classical dance.

To understand the importance of health through Indian classical dance, strengthen the body capacity.

To understand mythology and its characters in Indian classical dance form through lessons of Abhinaya.

Course Outcomes:

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

To be able to identify and appreciate the classical dance forms.

To be able to execute basics of Adavus with finesse.

To be able to express through abhinaya.

To be able to perform to perform the fundamentals in the chosen dance form.

Course Contents:

Unit 1

An introduction to Indian classical dance forms Bharatanatyam, Kuchipudi, Mohiniyattam

Unit 2

Learning of Fundamentals Exercises and Adavus- I (Bharathanatyam , Kuchipudi, Mohiniyattam)

Unit 3

Adavus –II (Bharathanatyam , Kuchipudi, Mohiniyattam)

Unit 4

Learn a basic composition in the chosen dance form.

Recommended Learning Resources (Text books):

Indian classical dance forms –U S Krishna Rao,U K Chandrabhaga Devi

Classical Dances –Sonal Mansingh, Avinash Parischa

Kuchipudi – Sunil Kothari

Bharatanatyam An in depth study- Saroja vydyanathan

Mohiniyattam – Bharathi Shivaji

H.PERCUSSION INSTRUMENT (TABLA AND MRIDANGAM)

Prerequisites:

Basics in Percussion instruments and knowledge of Rhythm/ Keen interest in studying Mridagam / Tabala.

Course Objectives:

The objectives of this course are to:

To understand the Rhythmology.

To understand the importance of Laya, Taala.

To be able to understand the fine finger techniques of playing the instrument.

Course Outcomes:

On successful completion of this course, students should be able to:

To be able to set instrument to Sruthi.

To be able to play the fundamentals on instrument.

To be able to learn and perform a particular taala.

Course Contents:

UNIT- 1

Introduction to Musical Instruments

Percussion Instruments

Mridangam and its History

UNIT - 2

Introduction to Tala System

Definitions of 5 jaathis and their recitation

Adi Talam and its various forms

Definitions and recitation of different gathis

UNIT- 3

1. Tisra Jaathi, 2. Khanda Jaathi, 3. Misra jaathi, 4. Sankeerna Jaathi

UNIT - 4

1. Learning of Jathi Formation, 2. Basic jathis, 3. Jathis for Dance forms

4. Some Basic Definitions of Korvai, Teermanam etc.,

Recommended Learning Resources (Text books):

1. Mridangam- An Indian Classical Percussion Drum – Shreejayanthi Gopal
2. Theory and practice of Tabala – Sadanand Naimpally.
3. Theory and practice of Mridangam – Dharmala Rama Murthy
4. The Art of the Indian Tabala – Srdjan Beronja.
5. Indian Tabala – Srdjan Beronja.

Course Code	Course Title	Duration		L	T	P	C
M19TCS6010	**Project Work Phase – II and Dissertation**	**16 Weeks**	**HC**	**0**	**0**	**16**	**16**

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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