REVA UNIVERSITY
Bengaluru, India

School of Computer Science & Engineering

M. Tech. in Computer Science and Engineering [PART TIME]

Handbook 2021-24

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

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HANDBOOK

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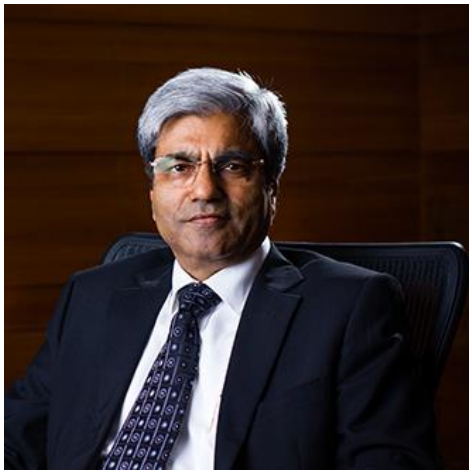
Phone No: +91-9021190211/080-46966966

Rukmini Educational
Charitable Trust

www.reva.edu.in

Chancellor's Message



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

- Nelson Mandela.

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

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

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

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

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

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

The last two decades have seen a remarkable growth in higher education in India and across the globe. The move towards inter-disciplinary studies and interactive learning have opened up several options as well as created multiple challenges. India is at a juncture where a huge population of young crowd is opting for higher education. With the tremendous growth of privatization of education in India, the major focus is on creating a platform for quality in knowledge enhancement and bridging the gap between academia and industry.A strong believer and practitioner of the dictum "Knowledge is Power", REVA University has been on the path of delivering quality education by developing the young human resources on the foundation of ethical and moral values, while boosting their leadership qualities, research culture and innovative skills. Built on a sprawling 45 acres of green campus, this 'temple of learning' has excellent and state-of-the-art infrastructure facilities conducive to higher teaching-learning environment and research. The main objective of the University is to provide higher education of global standards and hence, all the programs are designed to meet international standards. Highly experienced and qualified faculty members, continuously engaged in the maintenance and enhancement of student-centric learning environment through innovative pedagogy, form the backbone of the University.All the programs offered by REVA University follow the Choice Based Credit System (CBCS) with Outcome Based Approach. The flexibility in the curriculum has been designed with industry-specific goals in mind and the educator enjoys complete freedom to appropriate the syllabus by incorporating the latest knowledge and stimulating the creative minds of the students. Bench marked with the course of studies of various institutions of repute, our curriculum is extremely contemporary and is a culmination of efforts of great think-tanks - a large number of faculty members, experts from industries and research level organizations. The evaluation mechanism employs continuous assessment with grade point averages. We believe sincerely that it will meet the aspirations of all stakeholders – students, parents and the employers of the graduates and postgraduates of RevaUniversity.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. M Dhanamjaya
Vice-Chancellor, REVA University

Director's –Message

I congratulate and welcome all the students to the esteemed School of Computer Science and Engineering. You are in the right campus to become a computer technocrat. The rising needs of automation in Industry 4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of computer science. 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 3 years duration and split into 6 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of CSE. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, AI, Data Science, and Systems. Theoretical foundations of engineering, science, and computer science are taught in first two Semesters. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization.

The important features of the M.Tech CSE are as follows: 1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, Genetic Engineering, NLP, Swarm Intelligence, IOT and Cybersecurity, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft 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 Computer Science and Engineering including cloudcomputing, 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. Ashwin kumar U M
Director, School of CSE

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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 Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Okalahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, 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, 2.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.

REVA University

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".

Mission

- 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 COMPUTER SCIENCE & ENGINEERING

The School has a rich blend of experienced and committed faculty who are well qualified in various aspects of Computer Science and Engineering apart from the numerous state-of-the-art digital classrooms and laboratories having modern computing equipment. The School offers B Tech in Computer Science and Engineering and postgraduate programs offered in the school are: M Tech in Computer Science and Engineering (Both Full time and 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

School of Computer Science and Engineering aspires to become an Innovative Technological Education and Research hub in developing excellent human resources through education of global standards that will inculcate technical competence, leadership qualities, ethical, moral values, research and innovative skills, social responsibility and entrepreneurship abilities.

Mission

- To create state of the art- Computing labs infrastructure and research facilities in Computer Science and Engineering.
- To provide student-centric learning environment in Computer Science and Engineering through innovative pedagogy and education reforms.
- To encourage research, innovation and entrepreneurship in Computer Science and Engineering through industry/academia collaborations and extension activities
- Organize programs through club activities for knowledge enhancement in thrust areas of Computer Science and Engineering.
- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism, moral and ethical values.

Quality Policy

The School of Computer Science and Engineering is committed to excellence through following policies.

1. Impart quality education by providing state of art curriculum, experimental learning, and state of the art labs.
2. Enhance skill set of faculty members through faculty development programmes and interaction with academia and industries.
3. Inculcate the competency in software/hardware design and programming through co-curricular activities like Hackathon, Project exihibition, Internship and Enterpreneuship Programme.
4. Provide soft skill and skill development training for personality development and better placement.
5. Promote innovation and research culture among students and support faculty members for better research and development activity.

MEMBERS OF BOARD OF STUDIES

Sl. NO	Name, Designation and Affiliation	Status	Correspondence Address
1.	**Dr Sunil Kumar S Manvi** Professor and Director School of CSE and CIT, REVA University	Chair Person	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
2.	**Dr Mallikarjuna Shastry P** Professor,School of CSE, REVA University	Member (Internal)	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
3.	**Dr Kiran Kumari Patil**, Professor, School of CSE, Director UIIC, REVA University	Member (Internal)	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
4.	**Dr Mallikarjuna M Kodabagi**, Assistant Director, School of CSE, REVA University	Member (Internal)	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
5.	**Dr Ashwin Kumar U M**, Professor and Assistant Director, School of CSE, REVA University	Member (Internal)	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
6.	**Dr.Gopal Krishna Shyam** Professor, School of CSE, REVA University	Member (Internal)	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
7.	**Mr. Chetan Shivakumar,** CEO & Cofounder, Aikaan Labs Pvt Ltd, Bengaluru	Member	CEO & Cofounder, Aikaan Labs Pvt Ltd, Bengaluru
8.	**Mr. Muralidhar Jahagirdhar**, Practice Head Engineering, ATMECS Technology Pvt Ltd, Hyderabad	Member	Practice Head Engineering, ATMECS Technology Pvt Ltd, Hyderabad
9.	**Mr. Ravikant Soni**, Technical Manager, Solution Architect, Standard Chartered bank, Bengaluru.	Member	Technical Manager, Solution Architect, Standard Chartered bank, Bengaluru.
10.	**Dr Sanjay**, HoD Dept. of ISE, NITTE Meenakshi Institute of Technology, Bengaluru	Member	HoD Dept. of ISE, NITTE Meenakshi Institute of Technology, Bengaluru
11.	**Dr Raghavendra Kulkarni**, Director of Academics, M. S. Ramaiah University of Applied Sciences, Bengaluru	Member	Director of Academics, M. S. Ramaiah University of Applied Sciences, Bengaluru

Program Overview

M.Tech in Computer Science and Engineering

Computer Science and Engineering (CSE) encompasses a variety of topics that relates to computation, like development of algorithms, analysis of algorithms, programming languages, and software design and computer hardware. Computer Science and 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 Scientist's invention of the transistor, which made modern-style computing possible, and landed them the 1956 Nobel Prizein Physics. Fordecades, 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 justbeginning.

Computers have become ubiquitous part of modern life and new applications are introduced everyday. The use of computer technologies is also commonplace in all types of organizations, in academia, research, industry, government, private and business organizations. As computers become even more pervasive, the potential for computer-related careers will continue to grow and the career paths in computer-related fields will become more diverse. Since 2001, global

information and communication technologies (ICTs) have become more powerful, more accessible, and more widespread. They are now pivotal in enhancing competitiveness, enabling development, and bringingprogresstoalllevelsofsociety.

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 andInternet, graphics and multimedia, training and support and computer industry specialists are some of the opportunities the graduates find.

The School of Computer Science and Engineering 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 Computer Science and Engineering, 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.

REVA UNIVERSITY
Bengaluru, India

School of Computer Science and Engineering

Program Educational Objectives (PEO's)

After few years of graduation, the graduates of M. Tech. (Computer Science & 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)

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

PO-1: 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.

PO-2: 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.

PO-3: 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.

PO-4: 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.

PO-5: 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.

PO-6: 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.

PO-7: 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.

PO-8: 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.

PO-9: 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.

PO-10: 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.

PO-11: 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.

REVA University Academic Regulations

M Tech., Degree Programs

(Applicable for the programs offered from 2020-21 Batch)

(Framed as per the provisions under Section 35 (ii), Section 7 (x) and Section 8 (xvi) & (xxi) of the REVA University Act, 2012)

1. **Title and Commencement:**

1.1 These Regulations shall be called **"REVA University Academic Regulations – M Tech., Degree Program 2020-21 Batch subject to amendments from time to time by the Academic Council on recommendation of respective Board of Studies and approval of Board of Management**

1.2 These Regulations shall come into force from the date of assent of the Chancellor.

2. **The Programs:**

These regulations cover the following M Tech., Degree programs of REVA University offered during 2020-21.

M Tech (Full Time) in:

Artificial Intelligence
Computer Science and Engineering
Computer Aided Structural Engineering
Construction Technology & Management
Digital Communication and Networking
Machine Design
Power Energy & Systems
Transportation Engineering and Management
VLSI and Embedded Systems

Also

M Tech (Part Time) in:

Computer Science and Engineering
VLSI and Embedded Systems

3. **Duration and Medium of Instructions for M Tech (Part Time) in Computer Science and Engineering.**

3.1 **Duration:** The duration of the M Tech Degree Program (Part Time) shall be **THREE years** comprising of **SIX** Semesters. A candidate can avail a maximum of 12 semesters - 6 years as per double duration norm, in one stretch to complete M Tech degree.

3.2 The medium of instruction shall be English.

4. Definitions:

4.1 **Course: "Course" means a subject, either theory or practical or both, listed under a programme;** Example: "Finite Element Method of Analysis" in M Tech Civil Engineering program, "Advanced Theory of Vibration" in M Tech., Mechanical program are examples of courses to be studied under respective programs.

Every course offered will have three components associated with the teaching-learning process of the course, namely:

L	**Lecture**
T	**Tutorial**
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 / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

Courses offered are classified as: Core Courses, Open Elective Courses, Project work / Dissertation

4.2.1 **Core Course:** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.2 **Foundation Course:** The foundation Course is a mandatory course which should be completed successfully as a part of graduate degree program irrespective of the program of study

4.2.3 **Hard Core Course (HC) simply core course:** 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

4.2.4 Soft Core Course (SC) (also known as Professional Elective Course)

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

4.2.5 Open Elective Course (OE):

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

4.2.6 Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems.

5. Eligibility for Admission:

5.1. The eligibility criteria for admission to M Tech Program (Full Time) of 2 years (4 Semesters) and (Part Time) of 3 years (6 Semesters) are given below:

Sl. No.	Program	Duration	Eligibility
1	Masters of Technology (M Tech) in Artificial Intelligence	4 Semesters (2 years)	B E / B.Tech. in CSE / ISE / TE / MCA / M. Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
2	M Tech in Computer Science and Engineering	**Full Time** – 4 Semesters (2 years) **Part Time** – 6 Semesters (3 years)	B E / B.Tech. in ECE / IT / EEE / CSE / ISE / TE / MCA / M.Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
3	M Tech in Computer Aided Structural Engineering Construction	4 Semesters (2 years)	BE/ B.Tech. in Civil Engineering with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.

	Technology & Management Transportation Engineering and Management		
4	M Tech in Power Energy & Systems	4 Semesters (2 years)	BE/ B.Tech. in EE/ EEE/ ECE/ CSE/ MS / M.Sc. in Mathematics/Physics/Electronics / Information Technology or Information Science with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
5	M Tech in Digital Communication and Networking Machine Design	4 Semesters (2 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.
6	M Tech in VLSI and Embedded Systems	**Full Time** – 4 Semesters (2 years) **Part Time** – 6 Semesters (3 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.
7	M Tech in Machine Design	4 Semesters (2 years)	BE / B.Tech. in Mechanical/Aeronautical / Automobile / Industrial Production Engineering with a minimum of 50% (45% in case of candidate belonging to SC/ST category) marks in aggregate, of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.

5.2 Provided further that the eligibility criteria are subject to revision by the Government Statutory Bodies, such as AICTE, UGC from time to time.

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

6.2 Each semester is for a total duration of 20 weeks out of which 16 weeks dedicated for teaching and learning and the remaining 4 weeks for final examination, evaluation and announcement of results

6.3 The credit hours defined as below

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

1 credit = 13 credit hours spread over 16 weeks or spread over the semester
The total duration of a semester is 20 weeks inclusive of semester-end examination.

2 The following table describes credit pattern

Table -2: Credit Pattern

Lectures (L)	Tutorials (T)	Practice (P)	Credits (L:T:P)	Total Credits	Total Contact Hours
4	2	0	4:1:0	5	6
3	2	0	3:1:0	4	5
3	0	2	3:0:1	4	5
2	2	2	2:1:1	4	6
0	0	6	0:0:3	3	6
4	0	0	4:0:0	4	4
2	0	0	2:0:0	2	2

a. The concerned BoS will choose the convenient Credit Pattern for every course based on size and nature of the course

7. Different C**ourses of Study**:

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

a. Core Course (CC)
b. Foundation Course (FC)
c. Hard Core Course (HC)
d. Soft Core Course (SC)
e. Open Elective Course (OE)
f. Minor Project
g. Major Project / Dissertation:

The credits for minor projects, major project/Dissertation will be decided by the respective Schools.

8. Credit and Credit Distributions:

8.1 A candidate has to earn 72 credits for successful completion of M.Tech degree with a distribution of credits for different courses as prescribed by the University.

8.2 A candidate can enroll for a maximum of 24 credits per Semester. However s/he may not successfully earn a maximum of 24 credits per semester. This maximum of 24 credits does not

include the credits of courses carried forward by a candidate.

8.3 **Only candidates who register for a minimum prescribed number of credits in each semester from I semester to VI semester and complete successfully 72 credits in 6 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**.

9. Assessment and Evaluation

9.1 The assessment and evaluation process happens in a continuous mode. However, for reporting purpose, a Semester is divided into 3 components as IA1, IA2 and SEE. The performance of a candidate in a course will be assessed for a maximum of 100 marks as explained below.

(i) Component IA1:

The first Component (IA1), of assessment is for 25 marks. This will be based on test, assignment / seminar. During the first half of the semester (i.e. by 8th week), the first 50% of the syllabus (Unit 1&2) will be completed. This shall be consolidated during the first three days of 8th week of the semester. A review test based on IA1 will be conducted and completed in the beginning of the 9th week. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed in the beginning of the 9th week. The academic sessions will continue for IA2 immediately after completion of process of IA1.

The finer split - up for the award of marks in IA1 is as follows:

Assignment & Seminars ..... 10 marks for the first 20% of the syllabus

Test (Mid-Term)..... 15 marks for the first 30% of the syllabus

Total.....25 marks

(ii) Component IA2:

The second component (IA2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining units in the course will be completed. A review test based on IA2 will be conducted and completed during 16th week of the semester. In case of courses

where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

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

The finer split - up for the award of marks in IA2 is as follows:

Assignment/Seminar… ..... 10 marks for the second 20% of the syllabus

Review Test (Mid-Term) ..... 15 marks for the second 30% of the syllabus

Total..... 25 marks

(iii) Component SEE:

The Semester End Examination of 3 hours duration for each course shall be conducted during the 18th & 19th week. **This forms the third / final component of assessment (SEE) and the maximum marks for the final component will be 50.**

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

Component	Period	Syllabus	Weightage	Activity
IA1	1st Week to 8th Week	First 50% (two units)		Instructional process and Continuous Assessment
	Last 3 days of 8th Week		25%	Consolidation of IA1
IA2	9th week to 16th week	Second 50% (remaining two units)		Instructional process and Continuous Assessment
	Last 3 days of 16th week		25%	Consolidation of IA2
SEE	17th and 18th week			Revision and preparation for Semester end examination
	19th week to 20th week	Entire syllabus	50%	Conduct of semester end examination and Evaluation concurrently
	21st week			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 week**				

Note: 1. Practical examination wherever applicable shall be conducted before conducting of IA2 examination. The calendar of practical examination shall be decided by the respective school.

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

9.3 The Assessment of MOOC and Online Courses shall be decided by the concerned School Board of Studies (BOS).

9.3.1 For > 3 credit courses

i	IA-I	25 marks
ii	IA-2	25 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc)	50 marks
	Total	**100 marks**

9.3.2 For 1 & 2 credit courses

i	IA-I	15 marks
ii	IA-2	15 marks
iii	Semester end examination by the concern school board (demo, test, viva voice etc)	20 marks
	Total	**50 marks**

9.3.3 The 50 marks meant for Internal Assessment (IA) of the performance in carrying out practical shall further be allocated as under:

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

In case of an integrated course 20% marks be earmarked for laboratory work.

For example:

During IA1

Laboratory work.....10 marks

Test (Mid-Term).....15 marks for the first 50% of the theory syllabus

Total.....25 marks

During IA2

Laboratory work.....10 marks

Test (Mid-Term).....15 marks for the second 50% of theory syllabus

Total.....25 marks

SEE to be conducted for theory portions only and assessed for 50 marks

10. Setting Questions Papers and Evaluation of Answer Scripts:

10.1 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.

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

10.3 There shall be double evaluation, viz, first valuation by the internal evaluator who has taught the course and second evaluation shall be an external examiner who is familiar with the course. The average marks of the two evaluations (internal examiner & external examiner) shall be the marks to be considered for declaration of results.

10.4 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.

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

10.6 In case of a course with only practical component a practical examination will be conducted with two examiners 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.

10.7 The duration for Semester-End practical examination shall be decided by the Controller of Examinations.

11. 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	(IA1)	Periodic Progress and Progress Reports (25%)
Component – II	(IA2)	Results of Work and Draft Report (25%)
Component– III	(SEE)	Final Evaluation and Viva-Voce (50%). Evaluation of the report is for 30% and the Viva-Voce examination is for 20%.

12. All assessments must be done by the respective Schools as per the guidelines issued by the Controller of Examinations. However, the responsibility of announcing final examination results and issuing official transcripts to the students lies with the office of the Controller of Examinations.

13. Requirements to Pass a Course

13.1 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 40% in the SEE and an overall 40% (IA1+IA2+SEE) in a course is said to be successful.

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

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A
60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

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

Here, P is the percentage of marks (P= [(IA1+IA2) +SEE] secured by a candidate in a course which is **rounded to nearest integer**. v is the credit value of course. G is the grade and GP is the grade point.

a. 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.

b. Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade)
Course 1	**3**	**A**	**9**	**3X9=27**
Course 2	**3**	**B**	**8**	**3X8=24**
Course 3	**3**	**C**	**7**	**3X7=21**
Course 4	**3**	**O**	**10**	**3X10=30**
Course 5	**3**	**D**	**6**	**3X6=18**
Course 6	**3**	**O**	**10**	**3X10=30**
Course 7	**2**	**A**	**9**	**2X 9 = 18**
Course 8	**2**	**B**	**8**	**2X 8 = 16**
	22			**184**

Thus, **SGPA = 184 ÷ 22 = 8.36**

c. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (72) for two year post graduate degree in a specialization 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	10	8.0	80.00
2	11	8.9	97.90
3	12	8.08	96.96
4	11	8.18	89.98
5	12	8.33	99.96
6	16	9.5	152.00
Cumulative	72		616.8

Thus, **CGPA** = $\frac{10x10 + 8.9x11 + 8.08x12 + 8.18x11 + 8.33x12 + 9.5x16}{72}$ = 8.57

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 8.57 x 10=85.70

14. Classification of Results

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

CGPA	Grade (Numerical Index)	Letter Grade	Performance	FGP
	G			Qualitative Index
9 >= CGPA 10	10	O	Outstanding	Distinction
8 >= CGPA < 9	9	A+	Excellent	
7 >= CGPA < 8	8	A	Very Good	First Class
6 >= CGPA < 7	7	B+	Good	
5.5> = CGPA < 6	6	B	Above average	Second Class
> 5 CGPA < 5.5	5.5	C+	Average	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

a. **Provisional Grade Card:** The tentative / provisional Grade Card will be issued by the Controller of Examinations 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.

b. **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 COE.

15. Attendance Requirement:

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

15.2 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.

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

16. Re-Registration and Re-Admission:

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

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

17. Absence during Internal Test:

In case a student has been absent from an internal tests due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned Director of the School, for conducting a separate internal test. The Director of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special internal test for such candidate(s) well in advance

before the Semester End Examination of that respective semester. Under no circumstances internal tests shall be held / assignments are accepted after Semester End Examination.

18. Eligibility to Appear for Semester End Examination (SEE)

18.1 Only those students who fulfill 75% attendance requirement and who secure minimum 30% marks in IA1 and IA2 together in a course are eligible to appear for SEE examination in that course.

18.2 Those students who have 75% of attendance but have secured less than 30% marks in IA1 and IA2 together in a course are not eligible to appear for SEE examination in that course. They are treated as dropped the course and they will have to repeat that course whenever it is offered.

18.3 In case a candidate secures more than 30% in IA1 and IA2 together but less than 40% in aggregate of IA1, IA2 and SEE in a course is considered as unsuccessful and such a candidate may either opt to DROP that course or appear for SEE examination during the subsequent semesters / years within the stipulated period.

18.4 In such a case wherein he / she opts to appear for just SEE examination, then the marks secured in IA1 and IA2 shall get continued. Repeat SEE examination will be conducted in respective semesters.

19. Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 40% (20 marks) in Semester End Examination (SEE) and a minimum of 40% marks overall (IA and SEE together), such candidate shall seek supplementary examination of only such course(s) wherein his / her performance is declared unsuccessful. The supplementary examinations are conducted after the announcement of even semester examination results. The candidate who is unsuccessful in a given course(s) shall appear for supplementary examination of odd and even semester course(s) to seek for improvement of the performance.

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

A candidate who secures a minimum of 40% in the SEE and an overall 40% (IA1+IA2+SEE) in a course is said to be successful otherwise considered that the candidate has failed the course. A candidate is required to successfully complete all the courses before submission of major project report or dissertation report.

(It means that the candidate has no restrictions on the number of courses that can be carried forward)

21. Provision for Appeal

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

22. Grievance Committee:

In case of students having any grievances regarding the conduct of examination, evaluation and announcement of results, such students can approach Grievance Committee for redressal of grievances. Grievance committees will be formed by CoE in consultation with VC

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

- The Controller of Examinations - 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.

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

M.Tech in Computer Science and Engineering
Scheme of Instructions

(Effective from the Academic Year 2020-21)

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Credit Value				No. of Hrs.
				L	T	P	C	
FIRST SEMESTER								
1	M20TD0101	Advanced Database Management Systems	HC	3	0	0	3	3
2	M20CS0101	Advanced Machine Learning	HC	3	0	1	4	5
3	M20TD0102	Advanced Java Programming	HC	3	0	0	3	3
		Total Credits for the First Semester					**10**	**11**
SECOND SEMESTER								
1	M20TDS211	Cloud Computing Tools	SC	2	0	1	3	4
	M20TDS212	Advanced Web Technologies						
	M20TDS213	Distributed Computing						
2	M20TDS221	Big Data Analytics	SC	3	0	1	4	5
	M20TDS222	Wireless and Mobile Networks						
	M20TDS223	User Interface (UI)/User Experience (UX) Design						
3	M20TDS231	Unix System Programming	SC	3	0	1	4	5
	M20TDS232	Mobile Application Development						
	M20TDS233	Python for Data Analysis						
		Total Credits for the Second Semester					**11**	**14**
THIRD SEMESTER								
1	M20TD0301	Advanced Algorithms	HC	3	0	0	3	3
2	M20TD0302	Internet of Things	HC	3	0	1	4	5
3	M20CI0303	Python for Artificial Intelligence	HC	2	0	1	3	4
4	M20TD0304	Mini Project	HC	0	0	2	2	4
		Total Credits for the Third Semester					**12**	**16**

FOURTH SEMESTER								
1	M20TDS411	High Performance Computing	SC	3	0	1	4	5
	M20TDS412	Program Analysis						
	M20TDS413	Block Chain Technology						
2	M20TDS421	Robotic Process Automation	SC	3	0	0	3	3
	M20TDS422	Agile Software Development						
	M20TDS423	Deep Learning						
3	M20TD0403	Cyber Security Lab	HC	0	0	2	2	4
4	M20TD0404	Mini Project	HC	0	0	2	2	4
Total Credits for the Fourth Semester							**11**	16
FIFTH SEMESTER								
1	M20TDS511	Virtual and Augmented Reality	SC	3	0	1	4	5
	M20TDS512	Computer Vision						
	M20TDS513	Natural Language Processing						
2	M20TDO502	Open Elective	OE	4	0	0	4	4
3	M20TD0503	Capstone - Project Work Phase-1	HC	0	0	4	4	8
4	M20TD0504	Global Certification	HC	0	0	4	4	8
Total Credits for the Fifth Semester							**16**	25
*(OE) This course must be completed, but will not be graded and considered for computing CGPA/SGPA								
SIXTH SEMESTER								
1	M20TD0601	Capstone - Project-Work Phase-2 and Dissertation	HC	0	0	12	12	28
Total Credits for the Fourth Semester							**12**	28
Total Credits for all Four Semesters is 72								

Note:

Capstone Project work Phase – 1 comprises of literature survey, review paper writing, and problem formulation, identification of tools and techniques, and methodology for the project.

Capstone Project work, should have an outcome, publication in a reputed National/International Journal or a patent filing to earn 2 credits.

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

The registration for Global Certification Program must happen before the beginning of fifth semester.

First Year

Detailed Syllabus

Semester - I
Syllabus

Course Title	Advanced Database Management Systems				Course Type	Theory	
Course Code	M20TD0101	Credits	3		Class	I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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:

1. The objectives of this course are to:
2. Explain the concepts of DBMS and SQL
3. Discuss the Object oriented concepts and object relational Databases
4. Demonstrate the use of parallel and distributed databases in real world applications
5. Illustrate the development of Enhanced Data Model for given applications.

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Solve queries using SQL for real world applications	1,2,3,4,5	1,2,3
CO2	Make use of the Object oriented concepts in relational databases for real world applications.	1,2,3,4,5	1,2,3
CO3	Design parallel and distributed databases, Query database and incorporate recovery mechanisms.	1,2,3,4,5	1,2,3
CO4	Develop Enhanced Data Model for given real world applications	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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 ,

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.

JOURNALS/MAGAZINES

1. IEEE Transactions on Advance Data Base Management
2. Springer Journal of Advance Data Base Management
3. Elsevier Journal of Advance Data Base Management

SWAYAM/NPTEL/MOOCS:

1. https://www.udemy.com/ Data Base Management
2. https://www.coursera.org/learn/ Data Base Management
3. https://nptel.ac.in/courses/106106139/

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Machine Learning</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20CS0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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. Explain the basic blocks of machine learning and the techniques involved.
2. Discuss the various Learning trees used in real world problems.
3. Illustrate the use of different Linear Models in real world problems
4. Demonstrate the use of different dimensionality reduction techniques.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
C01	Apply the basic blocks of machine learning and the techniques involved	1,2,3,4,5	1,2,3
C02	Analyze the various Learning trees used in real world problems.	1,2,3,4,5	1,2,3
C03	Design simple linear models to solve real world problems.	1,2,3,4,5	1,2,3
C04	Formulate different dimensionality reduction techniques to real world problems.	1,2,3,4,5	1,2,3

5. BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

6. COURSE ARTICULATIONMATRIX

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

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.

TEXT BOOKS:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

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

JOURNALS/MAGAZINES:

1. IEEE Transactions on Pattern Analysis and Machine Intelligence

1 Springer Journal of Machine Learning

2 Elsevier Journal of Machine Learning with Applications

SWAYAM/NPTEL/MOOCS:

1. https://www.udemy.com/machinelearning/
2. https://www.coursera.org/learn/machine-learning
3. https://nptel.ac.in/courses/106106139/

PRACTICE:

<table>
<tr><th>Sl.No.</th><th>List of experiments</th></tr>
<tr><td>1.</td><td>R Studio is an integrated development environment (IDE) for R. It includes a console, syntax-highlighting editor that supports direct code execution, as well as tools for plotting, history, debugging and workspace management. Install R studio and Pacakages.</td></tr>
<tr><td>2.</td><td>Machine learning involves learning using different datasets, Perform Data Preprocessing on datasets using R TOOL.
• Importing the dataset. Dealing with missing values, dealing with categorical data, splitting the data into Training ang and Test data sets, scaling the features.</td></tr>
<tr><td>3.</td><td>Decision tree are powerful non-linear classifiers, which utilize a tree structure to model the relationships among the features and the potential outcomes. A decision tree classifier uses a structure of branching decisions, which channel examples into a final predicted class value.The C4.5 algorithm is an extension of the ID3 algorithm and constructs a decision tree to maximize information gain (difference in entropy).Apply C 4.5 algorithm classification of Iris data set/ Fruad detection using bank data.</td></tr>
<tr><td>4.</td><td>A Naive Bayes classifier is a probabilistic machine learning model that’s used for classification task.
Classify whether a given person is a male or a female based on the measured features. Consider the following data, which tells us the person’s class depending upon gender and height.
<table>
<tr><td>Name</td><td>Gender(M/F)</td><td>Hieght(cms)</td><td>Class)Medium/Short/Tall)</td></tr>
<tr><td>Radhika</td><td>F</td><td>188</td><td>Medium</td></tr>
</table>
</td></tr>
<tr><td>5.</td><td>Clustering is the process in which we divide the available data instances into a given number of sub-groups. These sub-groups are called clusters, and hence the name “Clustering”. To put it simply, the K-means algorithm outlines a method to cluster a particular set of instances into K different clusters, where K is a positive integer.
Demonstrate Clustering using k-means for the dataset.</td></tr>
<tr><td>6.</td><td>The EM (expectation maximization) technique is similar to the K-Means technique. Instead of assigning examples to clusters to maximize the differences in means for continuous variables, the EM clustering algorithm computes probabilities of cluster memberships based on one or more probability distributions.
Demonstrate the EM technique on a dataset using R.</td></tr>
<tr><td>7.</td><td>80% of customers who buy operating systems book and database management books also buy Computer Networks book and 75% of customers buy all these products together. This is an example of an association rule. Association rule searches for a pattern (a set of items, subsequences, substructures, etc.) that occurs frequently in a data set.

Demonstrate using R tool to determine Association rules for a given dataset.</td></tr>
</table>

8.	In statistics, linear regression is an approach for modeling the relationship between a scalar dependent variable y and one or more explanatory variables (or independent variables) denoted X. Linear regression is the most basic type of regression and commonly used for predictive analysis. These regression estimates are used to explain the relationship between one dependent variable and one or more independent variables.
9.	R's visualization allows to visualize a 2-D plot of the current working relation. Visualization is very useful in practice, it helps to determine difficulty of the learning problem. R can visualize single attributes (1-d) and pairs of attributes (2-d), rotate 3-d visualizations (Xgobi-style). R has "Jitter" option to deal with nominal attributes and to detect "hidden" data points. Demonstrate the visualization tool
10.	A Breadth-first search (BFS) is an algorithm for traversing or searching tree or graph data structures. It starts at the tree root (or some arbitrary node of a graph, sometimes referred to as a 'search key') and explores the neighbor nodes first, before moving to the next level neighbors. Write a python program to implement Breadth First Search Traversal.

Course Title	Advanced Java Programming				Course Type	Theory	
Course Code	M20TD0102	Credits	3		Class	I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	3	3	3	39	50	50

COURSE OVERVIEW:

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:

CO#	Course Outcomes	Pos	PSOs
CO1	Summarize the fundamentals of Java like object oriented programming, exception handling and multithreading to solve real world problems.	1,2,3,4,5	1,2,3
CO2	Choose proper component, like java servlets, java server pages etc., to develop a web application using J2EE	1,2,3,4,5	1,2,3
CO3	Apply advanced java concepts to manage sessions and cookies for optimal performance	1,2,3,4,5	1,2,3
CO4	Develop an application to establish communication between application and database.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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, Functional Interfaces, Lambda Expressions, Working with Collections, Stream APIs (Streams and Collectors) and Socket Programming.

SELF-LEARNING COMPONENT:

JAVA Model-View-Controller Pattern & Spring Framework.

TEXT BOOKS:

1. Bryan Basham, Kathy Sierra & Bert Bates, “Head First Servlets & JSP”, 2nd Edition, O’Reilly Publication, 2008.

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.

REFERENCE BOOKS:

1. Cay Horstmann, “Big Java: Late Objects”, 2nd Edition, John Wiley and Sons, 2016.
2. Herbert Schildt, “The Complete Reference Java J2SE”, 5th Edition, TMH Publishing Company Ltd, New Delhi.

JOURNALS/MAGAZINES:

1. Elsevier Journal on Computer Languages, Systems, and Strucutres
2. ACM Transactions on Programming Languages and Systems

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://nptel.ac.in/courses/106/105/106105191/

Semester - II
Syllabus

Course Title	Cloud Computing Tools				Course Type		Integrated	
Course Code	M20TDS211	Credits	3		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	2	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	**0**	-	-				
	Total	**3**	**5**	**5**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

This course provides a technical description of cloud computing technologies, covering cloud infrastructure and platform services. It describes emerging technologies critical to cloud computing. It also covers the fundamentals of cloud mechanisms. It provides the basics of virtualization, different types of virtualizations. It also provides cloud based application development, and working with OpenNebula and Eucalyptus tools.

COURSE OBJECTIVES:

The main objectives of this course are:

1. Discuss the concepts of Virtualizations and its applications
2. Explain Cloud based application development using AWS
3. Demonstrate Cloud deployment using OpenNebula
4. Illustrate Cloud operations using Eucalyptus.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Understand different virtualization technique through theoretical concepts and practical training	1,2,3,4,5	1,2,3
CO2	Develop Cloud based applications with AWS	1,2,3,4,5	1,2,3
CO3	Experiment applications deployment using OpenNebula	1,2,3,4,5	1,2,3
CO4	Create Cloud based scenarios using Eucalyptus	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT- 1

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

Unit -2

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

UNIT- 3

Containers and Cloud Native Computing: Introduction to containers, Overview of Dockers, Dockers Architecture and components (Docker Host – docker daemon, containers, images, Docker Client Docker Registry). Creating an application as docker Docker registry and introduction to dockerhub, Creating a docker image, Sharing images through registry (dockerhub), creating containers using docker, Virtual Machines vs Containers, Overview of Kubernetes , Kubernetes components and architecture.

UNIT- 4

Opennebula-A Cloud On VmwareVcenter: Overview: Open Cloud Architecture, VMware Cloud Architecture, OpenNebula Provisioning Model; OpenNebula Installation: Front-end Installation, MySQL Setup; Authentication Setup: SSH Authentication, x509 Authentication, LDAP Authentication

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Dan C. Marinescu, "Cloud Computing - Theory and Practice", Morgan Kaufmann is an imprint of Elsevier, 2013.
2. BirisLublinsky, Kevin T. Smith and Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN 13:9788126551071, 2015.

3. The Open Replacement for vCloud - Bring your VMware environment to the Cloud in 5 minutes. http://vonecloud.today/ ,http://docs.vonecloud.com/1.8/
4. A complete Guide to Docker. https:// docs.docker.com/get-started/resources/r Documentation
5. A introduction to Kubernetes. https://kubernetes.io/docs/concepts/

REFERENCE BOOKS:

1. Kevin Jackson, Cody Bunch, "OpenStack Cloud Computing Cookbook", Packt Publishing, 2013.
2. Cloud services for your virtual infrastructure, Part 1: Infrastructure-as-a-Service (IaaS) and Eucalyptus. http://www.ibm.com/developerworks/library/os-cloud-virtual1/
3. YohanWadia, "The Eucalyptus Open-Source Private Cloud". http://www.cloudbook.net/resources/stories/the-eucalyptus-open-source-privatecloud as on
4. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016.
5. OpenNebula 5.8 Deployment guide, Ebook available at: http://docs.opennebula.org/pdf/5.8/opennebula_5.8_deployment_guide.pdf

JOURNALS/MAGAZINES:

1. Elsevier Journal of Cloud Computing
2. IEEE Transactions on Cloud Computing
3. Springer Jounal of Cloud Computing

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Cloud Computing /
2. https://www.coursera.org/learn/ Cloud Computing
3. https://nptel.ac.in/courses/106106149/

PRACTICE:

SL.NO	LISTOF PROGRAM
1	This directive is a special purpose directive and is used to turn on or off some features. This type of directives are compiler-specific i.e., they vary from compiler to compiler. Some of the #pragma directives are discussed below: 1. **#pragma startup and #pragma exit**: These directives helps us to specify the functions that are needed to run before program startup(before the control passes to main()) and just before program exit (just before the control returns from main()).

	Design a Program on #pragrma using C.
2	OpenMP is a library for parallel programming in the SMP (symmetric multi-processors, or shared-memory processors) model. When programming with OpenMP, all threads share memory and data. OpenMP supports C, C++ and Fortran. The OpenMP functions are included in a header file called omp.h. Design a Program using Sections, omp for and omp single
3	Throughput computing focuses on delivering high volumes of computation in the form of transactions. Initially related to the field of transaction processing, throughput computing has since been extended beyond that domain. Throughput computing is realized by means of multiprocessing and multithreading, Multiprocessing is the execution of multiple programs in a single machine, where as multithreading relates to the possibility of multiple instruction streams within the same program. Design a Program using thread private directives.
4	Cloud computing is required by modern technology. Task scheduling and resource allocation are important aspects of cloud computing. Design a Program on scheduling.
5	Cloud computing transforms the way information technology (IT) is consumed and managed, promising improved cost efficiencies, accelerated innovation, faster time-to-market, and the ability to scale applications on demand. Design a Program using last private reduction, copying and shared.
6	A point-to-point communication always involves exactly two processes. One process sends a message to the other. This distinguishes it from the other type of communication in MPI, collective communication, which involves a whole group of processes at one time. Design a Program for Point to Point MPI calls
7	Login to the workshop cluster using user workshop username and OTP token. Copy the exercise files to user home directory. Familiarize user with LC's OpenMP environment. Write a simple "Hello World" OpenMP program. Successfully compile your program. Successfully run your program.Modify the number of threads used to run your program.
8	Login to the LC workshop cluster, if you are not already logged in. Sharing DO/for construct examples: review, compile and run. Work-Sharing SECTIONS construct example: review, compile and run.
9	Login to the workshop cluster. Orphaned directive example: review, compile, run. Get OpenMP implementation environment information .Hybrid OpenMP + MPI programs. Check out the "bug" program
10	**Mininet** is a system that supports the creation of lightweight logical nodes that can be connected into networks. These nodes are sometimes called **containers**, or, more accurately, **network namespaces**. Virtual-machine technology is not used. Install and configure Mininet SDN emulator with 2 traffic engineering experiment applications to understand how to program 'flow spaces' within networks to: (i) comply with enterprise network capacity provisioning policies, and (ii) balance the utilization of network resources – Use Iperf and Ping Tools to verify your SDN functionality

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Web Technologies</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS212</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
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<tr><td>Total</td><td>3</td><td>5</td><td>5</td><td>26</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course introduces the current and future forms of the Web, It is necessary to understand the underlying design principles and concepts, relevant issues and techniques. The fast changing nature of the Web means that such a deep understanding is essential to understand the latest developments and their potential. The topics covered in this course includes how to make web sites that serve "dynamic content": content that is based on returning or updating results in a database.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Discuss the fundamentals of Client side caching concepts in the area of web services.
2. Illustrate the design of JavaScript based web based applications.
3. Discuss the PHP based web based applications.
4. Describe optimization and security issues of a web and the mechanisms to make it more secure.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Summarize the fundamentals Client side caching concepts in the area of web services.	1,2,3,4,5	1,2,3
CO2	Design and Develop JavaScript based web based applications.	1,2,3,4,5	1,2,3
CO3	Design and Develop PHP based web based applications.	1,2,3,4,5	1,2,3
CO4	Optimize the web applications and mechanisms to make it more secure.	1,2,3,4,5,8	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

Utilizing Client-Side Caching: Introduction, Understanding the Types of Caching, Controlling Caching , Dealing with Intermediate Caches, Cache-Control Revisited, Caching HTTP Responses, DNS caching and prefetching, Search Engines: Searching techniques used by search engines, keywords, advertisements, Search Engine Optimization (SEO) for individual web pages: header entries, selection of URL; SEO for entire website: Hyperlinks and link structure.

UNIT-2

JavaScript: Introduction, Operators, ControlStructures, looping constructs, functions, Array declaration and allocation, Handling Events Using JavaScript, data validation using regular expressions. Object oriented JavaScript, callbacks, closures, modules, AJAX, JQuery.

UNIT-3

PHP: Introduction, Data Types, Operators, Control Flow; Functions; Exception Handling, Storing and Retrieving Data, Arrays, String Manipulation and Regular Expressions, Object-Oriented PHP, Authentication with PHP, Interaction with File System and Server, Form processing, Handling Images, Session Management, Cookies, Debugging, Building CMS application.

UNIT- 4

Optimization: Optimizing images, Load balancers, Tuning MYSQL, query caching, query execution and optimization, traffic generation.

Security: Introduction, Handling user access and user input, Bypassing client-side controls, Authentication, Session hijacking, Attacks on data stores: SQL query log, SQL injections; Attacks on Users: XSS attacks; Cross-site Request Forgery (CXRF), DoS and DDoS attacks, DNS Hijacking.

SELF-LEARNING COMPONENT:

Practical application of the latest evolving web technologies. Topics include HTMLS, CSS/SASS, JavaScript, NodeJS, Polymer, NoSQL, asynchronous programming, functional programming, event driven systems, debugging, testing, workflow optimization, and deployment pipelines.

TEXT BOOKS:

1. Peter Smith, “Professional Website performance”, Wiley India Pvt. Ltd, 2019.
2. Luke Welling Laura Thomson “PHP and MySQL Web Development” Fourth Edition, Pearson Education, 2009.

REFERENCE BOOKS:

1. Kogent Learning, “Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX – Black Book”, Wiley India Pvt. Ltd, 2009
2. Stuttard D., Pinto 2., “The Web Application Hackers Handbook”., Wiley India Pvt. Ltd, 2nd Ed, 2016
3. Deitel 3.2., Deitel P.J., “Internet & World wide Web: How to program”, 4th Ed., Pearson Education, 2007

JOURNALS/MAGAZINES:

1. Elsevier Journal of Advance Web Technology
2. IEEE Transactions on Advance Web Technology
3. Springer Jounal of Advance Web Technology
4. ACM Transactions on Internet Technology
5. ACM Transactions on Information Systems.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Advance Web Technology/
2. https://www.coursera.org/learn/ Advance Web Technology
3. https://nptel.ac.in/courses/106106149/

PRACTICE:

Sl. No.	List of experiments
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
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
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
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 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
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
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
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
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 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

<table>
<tr><td>Course Title</td><td colspan="4">Distributed Computing</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS213</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
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</table>

COURSE OVERVIEW:

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 objectives of this course are to:

1. Explain the various distributed systems and its architectures
2. Discuss various communication aspects in the distributed systems
3. Describe the consistency and replication, fault tolerance and security aspects
4. 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:

CO#	Course Outcomes	Pos	PSOs
CO1	Apply the concepts of distributed computing systems	1,2,3,4,5	1,2,3
CO2	Analyze the various communication aspects in the distributed systems	1,2,3,4,5	1,2,3
CO3	Design applications for consistency and replication, fault tolerance and security aspects	1,2,3,4,5	1,2,3
CO4	Make use of Distributed-Object based Systems, Distributed File Systems and Distributed Web-based Systems in real world applications	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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.

TEXT BOOKS:

1. Andrew S. Tanenbaum, "*Distributed Operating System",* Pearson, 2008.

2. George Coulouris, Jean Dollimore and Tim Kindberg, "*Distributed Systems: Concepts and design",* (4th ed.) Pearson, 2011.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, "Maarten Van Steen, *Distributed Systems: Principles and Paradigms"* (2nd ed.), Pearson, 2007.
2. Pradeep K. and Sinha, "*Distributed Operating System: Concepts and Design"* (2nd ed.), PHI, 2009.

JOURNALS/MAGAZINES:

1. Elsevier Journal of Distributed Computing
2. IEEE Transactions on Distributed Computing
3. Springer Jounal of Distributed Computing

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Distributed Computing/
2. https://www.coursera.org/learn/ Distributed Computing
3. https://nptel.ac.in/courses/106106149/

PRACTICE:

Sl. No.	**List of Programs**
1	In Distributed systems, we neither have shared memory nor a common physical clock and there for we can not solve mutual exclusion problem using shared variables. To eliminate the mutual exclusion problem in distributed system approach based on message passing is used. Write a program in c for implementation of non token base algorithm for distributed mutual exclusion.
2	The Lamport timestamp algorithm is a simple logical clock algorithm used to determine the order of events in a distributed computer system. As different nodes or processes will typically not be perfectly synchronized, this algorithm is used to provide a partial ordering of events with minimal overhead, and conceptually provide a starting point for the more advanced vector clock method. The algorithm is named after its creator, Leslie Lamport. Write a program in C to implement Lamports logical clock
3	In computer science, edge-chasing is an algorithm for deadlock detection in distributed systems. Developed by ChandyMisra Hass. Whenever a process *A* is blocked for some resource, a probe message is sent to all processes *A* may depend on. The probe message contains the process id of *A* along with the path that the message has followed through the distributed system. If a blocked process receives the probe it will update the path information and forward the probe to all the processes it depends on. Non-blocked processes may discard the probe. Write a program to implement edge chasing distributed deadlock detection algorithm.
4	The purpose of a lock is to ensure that among several nodes that might try to do the same piece of work, only one actually does it (at least only one at a time). That work might be to write some data to a shared storage system, to perform some computation, to call some external API, or suchlike. At a high level, there are two reasons why you might want a lock in a distributed application: for efficiency or for correctness . Write a program in C to implement locking algorithm.
5	The **RMI** (Remote Method Invocation) is an API that provides a mechanism to create distributed application in java. The RMI allows an object to invoke methods on an object running in another JVM.The RMI provides remote communication between the applications using two objects *stub* and *skeleton*. Write a program to implement Remote Method Invocation
6	RPC is a powerful technique for constructing distributed, client-server based applications. It is based on extending the notion of conventional or local procedure calling, so that the called procedure need not exist in the same address space as the calling procedure. The two processes may be on the same system, or they may be on different systems with a network connecting them. By using RPC, programmers of distributed applications avoid the details of the interface with the network. The transport independence of RPC isolates the application from the physical and logical

	elements of the data communications mechanism and allows the application to use a variety of transports. Write a Program to implement Remote Procedure Call.
7	A simple date time server was created which handled multiple user requests at the same time using threading. It explains the basic concepts of threading in network programming. The same concepts can be used with very slight modification to extend the above idea and create a chatting application similar to facebook messenger, whatsapp etc. Write a program to implement Chat Server
8	Algorithms for the detection of termination in a distributed system and analyzes them for effectiveness and efficiency. The algorithms are analyzed for the overhead and conclusions are made about the situations in which they can be used, i.e. an operating system, a real-time system, or a user application. An original algorithm is presented for the asynchronous case with first-in-first-out message ordering. It allows any process to initiate detection of termination and makes use of multiple tokens. Write a Program to implement termination detection
9	SOAP is an XML-based protocol for accessing web services over HTTP. It has some specification which could be used across all applications.SOAP is known as the Simple Object Access Protocol, but in later times was just shortened to SOAP v1.2. SOAP is a protocol or in other words is a definition of how web services talk to each other or talk to client applications that invoke them. Monitor SOAP request and response packets. Analyze parts of it and compare them with the operations (java functions) headers.
10	The Java Remote Method Invocation (RMI) mechanism and the Common Object Request Broker Architecture (CORBA) are the two most important and widely used distributed object systems. Each system has its own features and shortcomings. Both are being used in the industry for various applications ranging from e-commerce to health care. Selecting which of these two distribution mechanisms to use for a project is a tough task. Implement CORBA mechanism by using C++program at one end and Java program on the other.

<table>
<tr><td>Course Title</td><td colspan="4">Big Data And Analytics</td><td colspan="3">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS221</td><td>Credits</td><td colspan="2">4</td><td colspan="3">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="3" rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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:

1. Discuss the fundamentals of Hadoop distributed file system and Big Data Analytics.
2. Demonstrate Big Data Processing with MapReduce and Batch Analytics with Apache Spark.
3. Describe the implementation of Real-Time Analytics with Apache spark in real world Applications.
4. Illustrate the working of Stream Processing and also discuss the fundamentals of Cloud Computing

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the fundamentals of Hadoop distributed file system and Big Data Analytics	1,2,3,4,5	1,2,3
CO2	Apply Big Data Processing with MapReduce and Batch Analytics with Apache Spark to simple real world problems.	1,2,3,4,5	1,2,3
CO3	Implement Real-Time Analytics with Apache spark in real world Applications.	1,2,3,4,5	1,2,3
CO4	Develop data models for real world stream processingApplications	1,2,3,4,5	1,2,3

.**BLOOM'S LEVELOF THECOURSE OUTCOMES**

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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 Mapper's 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.

TEXT BOOKS:

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

2. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley India Pvt Ltd, April 2015.

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", CreateSpace Independent Publishing Platform, 2017.

JOURNALS/MAGAZINES:

1. Elsevier Journal of Big Data and Analytics
2. IEEE Transactions on Big Data and Analytics
3. Springer Jounal of Big Data and Analytics

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Big Data and Analytics
2. https://www.coursera.org/learn/ Big Data and Analytics
3. https://nptel.ac.in/courses/106106129/

PRACTICE:

Sl. No.	List of Programs
1	Hive is a data warehousing infrastructure tool built on the top of Hadoop. This article helps you to start quickly with the Hive by providing guidance about downloading Hive, setting and configuring Hive and launching HiveServer2, and the Beeline Command shell to interact with Hive. Installing Hadoop 3, Hive, Derby, R, Anaconda, Python, Apache Spark, Apache Flink, Tableu
2	As datasets grow and analytic algorithms become more complex, the typical workflow of analysts launching an analytic, waiting for it to complete, inspecting the results, and then re-launching the computation with adjusted parameters is not realistic for many real-world tasks. This paper presents an alternative workflow, progressive visual analytics, which enables an analyst to inspect partial results of an algorithm as they become available and interact with the algorithm to prioritize subspaces of interest. Progressive visual analytics depends on adapting analytical algorithms to produce meaningful partial results and enable analyst intervention without sacrificing computational speed. As datasets grow and analytic algorithms become more complex, the typical workflow of analysts launching an analytic, waiting for it to complete, inspecting the results, and then re-launching the computation with adjusted parameters is not realistic for many real-world tasks. Progressive visual analytics depends on adapting analytical algorithms to produce meaningful partial results and enable analyst intervention without sacrificing computational speed. 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
3	MapReduce is a kind of processing large scale data sets distributed Google proposed parallel programming model, also is Isthe current cloud computing core calculation model. Many scientific research institutions and companies are R & D design of a parallel processing system for massive data specification MapReduce based on their technology. 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
4	PIPELINE.In machine learning, it is common to run a sequence of algorithms to process and learn from data. E.g., a simple text document processing workflow might include several stages: • Split each document's text into words. • Convert each document's words into a numerical feature vector. • Learn a prediction model using the feature vectors and labels. A Pipeline is specified as a sequence of stages, and each stage is either a Transformer or an Estimator. These stages are run in order, and the input DataFrame is transformed as it passes through each stage. 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
5	Use Map Reduce framework to perform big data analytics on distributed clusters. By choosing public datasets that are openly available for the task identified. 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. Perform experiments and interpret the results obtained.
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. Perform experiments and interpret the results obtained.
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. Perform experiments and interpret the results obtained.

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 a) Batch Analytics application using Apache Spark. b) Real time-Analytics application using Apache Spark. (Note: choose data sets from Internet-bound big data repositories)
10	Develop any Batch-Analytics application using Apache Flink.

<table>
<tr><td>Course Title</td><td colspan="4">Wireless and Mobile Networks</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS222</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course will introduce to wireless communication and mobile computing. It covers the fundamentals of wireless transmission and telecommunication system such as GSM, GPRS, DECT, and UMTS. Mobile network layer and transport layers covers about mobile IP, Traditional TCP and the architecture of LTE and its protocol.

COURSE OBJECTIVES:

The objectives of this course are to

1. Explain the basic concepts of wireless communication.
2. Describe wireless network architecture and concepts of Ad-hoc network.
3. Demonstrate the working of wireless Local area networks and wireless ad-hoc networks.
4. Discuss various applications using the wireless technologies

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Outline the fundamental concepts of wireless communication.	1,2,3,4,5	1,2,3
CO2	Analyse the working of wireless network and wireless Ad-hoc network.	1,2,3,4,5	1,2,3
CO3	Make use of the Wireless Application protocol in a real world application.	1,2,3,4,5	1,2,3
CO4	Develop applications using the wireless technologies.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT -1

Introduction: Fundamentals of wireless communication: Wireless communication system, Wireless media, Frequency spectrum, Wireless communication channel specifications, Types of wireless communication systems.
Basics of wireless networks: Wireless network architecture, Wireless network reference model, Wireless networking issues.

UNIT -2

Telecommunication System: Global system for mobile communications (GSM) Services, System Architecture, Radio interface, protocol, handover, General packet radio service (GPRS). DECT System Architecture, protocol, TETRA, UMTS System Architecture.

Wireless Body Area Networks, Properties, Network architecture, Components, Network Protocols, Bluetooth and Zigbee, Applications.

UNIT -3

Wireless Local Area Networks: Network Components, Network architecture, WLAN standards, WLAN protocols, IEEE 802.11p, WLAN applications.

Wireless Ad Hoc Networks: Wireless Ad Hoc Networks, Mobile Ad Hoc networks, Wireless sensor networks, Vehicular Ad Hoc networks (VANETs).

UNIT -4

Wireless Application protocol: Version 1.X Architecture, WAP 2.0. 4G LTE Networks: Introduction, LTE, LTE Architecture, Protocol layer Architecture, LTE Advanced, 5G Networks overview.

SELF-LEARNING COMPONENTS:

Network Function Virtualization (NFV), Capability-based Security, 5G, Cyber Physical Systems (CPS**),** and Capability-based Security.

TEXT BOOKS:

1. Sunil Kumar S.Manvi, Mahabaleshwar S. Kakkasageri, “Wireless and mobile networks concepts and protocols”, second edition, Wiley, 2016.
2. Jochen S. Schillier, “Mobile Communications”, 2nd edition, Pearson publishers.

REFERENCE BOOKS:

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, “Mobile computing technology, Application and service creation”, Second edition, Tata McGraw Hill Education Private limited, 2010.

JOURNALS/MAGAZINES:

1. Elsevier Journal of Wireless and Mobile Networks
2. IEEE Transactions on Wireless and Mobile Networks
3. Springer Jounal of Wireless and Mobile Networks

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Wireless and Mobile Networks
2. https://www.coursera.org/learn/ Wireless and Mobile Networks
3. https://nptel.ac.in/courses/106106129/

PRACTICE:

SL.NO	List of Programs
1	Today's network simulators are widely used in the mobile world. Simulation networks are valuable tools with which to investigate the behavior and performance of new protocol designs, while reinforcing their understanding of networking concepts. Network simulation tools save money and time by offering researchers the possibility to test network protocols in virtual environments that might be difficult or expensive to emulate using real hardware, such as routers, computers, or switches. Introduction to: (a) discrete event simulation, (b) ns3, (c) ns3 Installation, (d) NetAnim.
2	The *ns-3* CSMA device models a simple network in the spirit of Ethernet. A real Ethernet uses CSMA/CD (Carrier Sense Multiple Access with Collision Detection) scheme with exponentially increasing backoff to contend for the shared transmission medium. Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyze the network performance using UDP client server.
3	Token ring in token bus the ring topology is virtually created and maintained by the protocol. A node can receive data even if it is not part of the virtual ring, a node joins the virtual ring only if it has data to transmit. In token bus data is transmitted to the destination node only where as other control frames is hop to hop. After each data transmission there is a solicit_successsor control frame transmitted which reduces the performance of the protocol. Write a NS 3 program to demonstrate bus topology. Analyze the performance using UDP based applications.
4	The star topology reduces the damage caused by line failure by connecting all of the systems to a central node. When applied to a bus-based network, this central hub rebroadcasts all transmissions received from any peripheral node to all peripheral nodes on the network, sometimes including the originating node. All peripheral nodes may thus communicate with all others by transmitting to, and receiving from, the central node only. Write a NS 3 program to demonstrate star topology. Analyze the performance using UDP based applications.
5	The Transmission Control Protocol (TCP) is one of the main protocols of the Internet protocol suite. It originated in the initial network implementation in which it complemented the Internet Protocol (IP). Therefore, the entire suite is commonly referred to as TCP/IP. TCP provides reliable, ordered, and error-checked delivery of a stream of octets (bytes) between applications running on hosts communicating by an IP network. Major Internet applications such as the World Wide Web, email, remote administration, and file transfer rely on TCP. Write a NS3 program to implement FTP using TCP bulk transfer, Analyze the performance
6	At the lower levels of the protocol stack, due to network congestion, traffic load balancing, or unpredictable network behaviour, IP packets may be lost, duplicated, or delivered out of order. TCP detects these problems, requests re-transmission of lost data, rearranges out-of-order data and even helps minimize network congestion to reduce the occurrence of the other problems. If the data still remains undelivered, the source is notified of this failure. Write a NS3 program to connect two nodes with a point to point link, which have unique interface. Analyse the traffic control using TCP by changing suitable parameters.

7	A mobile ad hoc network or MANET does not depend on a fixed infrastructure for its networking operation. MANET is an autonomous and short-lived association of group of mobile nodes that communicate with each other over wireless links. A node can directly communicate to the nodes that lie within its communication range. If a node wants to communicate with a node that is not directly within its communication range, it uses intermediate nodes as routers. Write NS 3 Program to configure two nodes on an 802.11b physical layer, with802.11b NICs in adhocmode, and by default, sends one packet of 1000 (application) bytes to the other node. The physical layer is configured to receive at a fixed RSS (regardless of the distance and transmit power); therefore, changing position of the nodes has no effect. Analyze the performance.
8	To find troubleshooting network issues, and to inspect individual packets, Wireshark is needed. Wireshark is the de facto, go-to, you-need-to-know-how-to-use, application to capture and investigate network traffic.SinceWireshark is the be-all-end-all tool for this job, – like where to download, how to capture network packets, how to use the Wireshark filters, and more.Installwireshark, and analyze the packets using it on a selected interface. Apply filters and check the packets.
9	Modern switches use virtual local-area networks (VLANs) to improve network performance by separating large Layer 2 broadcast domains into smaller ones. VLANs can also be used as a security measure by controlling which hosts can communicate. In general, VLANs make it easier to design a network to support the goals of an organization. Install packet tracer, and consider a topology and configure VLAN
10	Nmap, short for Network Mapper, is a free, open-source tool for vulnerability scanning and network discovery. Network administrators use Nmap to identify what devices are running on their systems, discovering hosts that are available and the services they offer, finding open ports and detecting security risks.Nmap can be used to monitor single hosts as well as vast networks that encompass hundreds of thousands of devices and multitudes of subnets. Install NMAP, and execute atleast 10 commands to demonstrate the scanning of networks hosts and ports.

<table>
<tr><td>Course Title</td><td colspan="4">User Interface (UI)/User Experience (UX) Design</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS223</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the new technologies that provide interactive devices and interfaces in real world applications	1,2,3,4,5	1,2,3
CO2	Implement the UI/UX design process and evaluate UID.	1,2,3,4,5	1,2,3
CO3	Develop applications using various Interaction styles including Direct Manipulation and Virtual Environment..	1,2,3,4,5	1,2,3
CO4	Elaborate the command, natural languages and issues in design for maintaining QoS.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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.

TEXT BOOKS:

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

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, Principles and Techniques”, Wiley-Dreamtech India Pvt Ltd, 2015.

JOURNALS/MAGAZINES:

1. Elsevier Journal of User Interface / User Experience
2. IEEE Transactions on User Interface / User Experience
3. Springer Jounal of User Interface / User Experience

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ User Interface / User Experience
2. https://www.coursera.org/learn/ User Interface / User Experience
3. https://nptel.ac.in/courses/106106129/

PRACTICE:

SL.NO	List of Programs
1	Suppose you need to design a system for users in two countries that are very different from each other culturally. What are some of the design concerns that you should be aware of to create a successful design?
2	Don Norman suggests organizing screens and menus functionally, designing commands and menu choices to be distinctive, and making it difficult for users to take irreversible actions. Norman also says to provide feedback about the state of the interface (e.g., changing the cursor to show whether a map interface is in zoom- in or select mode) and designing for consistency of actions (e.g., ensuring that Yes/No buttons are always displayed in the same order). State one example you have seen where you know these rules have been violated. Although this is crucial to a user interface's success, suggest why there may be challenges to implement some of Norman's guidelines
3	You are the new Chief Design Officer (COO) of a start-up, DTUI Inc. The project is to design a system for selling pottery. The aim is to develop an interface that meets the needs of both the potters and the customers. Describe in detail a design methodology of four stages to facilitate the proper design of such a system. Write your answer in the form of a management plan for this project. For each stage, indicate the number of weeks that should be allocated. Hint: Note the four phases of the design process: 1. Requirements analysis 2. Preliminary (conceptual) and detailed design 3. Build and implementation 4. Evaluation
For questions 4 - 6, refer the following scenario: The State of Maryland is developing a web-voting interface. For selecting the candidates, one design (RB) is a set of radio buttons and another is (CB) a combo-box (drops down when selecting the scroll arrow icon), both using standard fonts at 10-point size.	
4	Compare these two designs when there are four candidates and predict the relative speed of performance and error rates. Support your choice by a thoughtful argument.
5	An expert reviewer complains that both designs may work with young users who are familiar and expert in using a mouse, but that there will be problems for elderly and motor-impaired users who have difficulty controlling a mouse. The reviewer recommends a new design that includes a larger font (20-point size) and a numbered list to allow selection by keyboard easily. Describe a participatory design or social imp act statement process that might clarify this issue with elderly users.
6	Design an experiment to help resolve the issue brought up in question 5. Assume you have substantial resources and access to subjects.
7	Consider a system that does not yet exist; for example, a totally automated fast-food restaurant , where customers order via touch screen interactions, pay by swiping their debit or credit cards, and then pick up their food analogous to the self-check-out at some supermarkets, but even more extreme. Discuss how you would conduct a co11textual inquiry for a system that does not yet exist.

8	An airline company is designing a new online reservation system. They want to add some direct-manipulation features. For example, they would like customers to click a map to specify the departure cities and the destinations, and to click on the calendar to indicate their schedules. From your point of view, list four benefits and four problems of the new idea compared with their old system, which required the customer to do the job by typing text.
9	A company is designing a kiosk that can display weather information in public locations. The kiosk will feature a touch screen so users can select a city by pointing on a map. Give three reasons why a touch screen is an effective device for this application.
10	Your documentation team has developed an online help support for instant messaging client. You are hiring a usability testing firm to evaluate the online help and recommend improvements. Prepare a contract that specifies how you want the usability test to be performed and what reports you would like to receive. Your schedule gives them one week to prepare the study, one week to run it, plus one week to write up the final report. In your contract, specify the details of your requirements, including such information as the number of subjects required, test plans, and the types of reports.

SELF LEARNING:

A group decision system is being built over a network, which has inherent delays due to network lag. Suggest the longest acceptable amount of time the delay could last without affecting the user negatively. Provide an argument for the time you selected.

- System confirming the user's password when logging on.
- Synchronous group editing of a document.
- Asynchronous critiquing of other participants' work.

<table>
<tr><td>Course Title</td><td colspan="4">Unix System Programming</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS231</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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</table>

COURSE OVERVIEW:

This course is an introduction to basic concepts of various fields of UNIX operating system is called the kernel. The kernel denes the application programming interface and provides all of UNIX's services, whether directly or indirectly. The kernel is a program, or a collection of interacting programs, depending on the particular implementation of UNIX, with many entry ointsp 15.

COURSE OBJECTIVES:

Objectives of this course are to:

1. Discuss the UNIX, ANSI Standardsand POSIX API'S forfiles.
2. Describe the API's for implementing process control and to Identify System call interface for process management, multitaskingprograms.
3. Demonstrate the use of Signals and Daemon processes inUNIX.
4. Explain different API's and IPCmethods.
5. On completion of this course; the student will be able to:

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of POSIX API'S to work with files.	1,2,3,4,5	1,2,3
CO2	Apply the API's for implementing UNIX commands, process control and processmanagement.	1,2,3,4,5	1,2,3
CO3	Utilize Signals and Daemon processes in UNIX.	1,2,3,4,5	1,2,3
CO4	Develop programs for message queues, FIFO programs and data transfer socket using appropriate API's, IPC methods and Sockets.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT1

UNIX and ANSI Standards: ANSI C standard, ANSI/ISO C++ standards, Difference between ANSIC and C++, POSIX standards, POSIX.1 FIPS standard, X/Open standards. UNIX and POSIX APIs: POSIX APIs, UNIX and POSIX development Environment, API common characteristics

Files: File types, Unix and POSIX file system, Unix and POSIX file attributes, INODES in Unix System V, Application program interface to files, Unix kernel support for files, Relationship of C stream pointers and file descriptors, Directory Files, Hard and Symbolic links.

UNIX File APIs: General File APIs, File and Record locking, Directory File APIs, Device file APIs, FIFO file APIs, Symbolic Link File APIs.

UNIT 2

UNIX Processes: Environment of UNIX process: Introduction to main function, Process Termination, Command Line Argument, Environment list.

Process Control: Introduction, Processidentifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 functions, Raceconditions, exec functions, changing Users IDs and Group IDs, Interpreter files, System function, Process accounting, User identification, Process times, I/O Redirection.

ProcessRelationship: Introduction, Terminal login, Network login, process groups, sessions, job control, Shell execution of programs, Orphaned processgroups.

UNIT 3

Signals: Unix Kernel support for signals, signal, Signal mask, Sigaction, SIGCHLD signal and waitpid function, sigsetjmp and siglongjmp functions, Kill, Alarm, Interval Times, POSIX.lb timers,

Daemon processes: Introduction, Daemon characteristics, Coding Rules, Error logging, Client servermodel.

UNIT 4

Inter Process Communication: Overview of IPC methods, Pipes, Popen, Pclose functions, Co- processes, FIFOs system V IPC, Message Queues, Semaphores, Shared Memory, Client server properties, Stream pipes, Passing File descriptors, an open server version1 and Client server connections functions.

SELF LEARNING COMPONENT

OPENMP, OPENMPI, Sockets

TEXT BOOKS:

1. Terrence Chan, “UNIX System Programming Using C++”, Prentice Hall India, 2011.
2. Stephen A. Rago, W. Richard Stevens, “Advanced Programming in the UNIX Environment”, Third edition, Pearson Education / PHI, 2013.

REFERENCE BOOKS:

1. Kay A. Robbins and Steven Robbins, "UNIX Systems Programming: Communication, Concurrency, and Threads", Prentice Hall; 2nd edition, December 2015.
2. W. Richard Stevens, "UNIX Network Programming, Interprocess Communications", 2nd Edition, Addison-Wesley, 2015

JOURNALS/MAGAZINES:

1. Elsevier Journal of UNIX Sytem Programming
2. IEEE Transactions on UNIX Sytem Programming
3. Springer Jounal of Unix Sytem Programming

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/ Unix Sytem Programming
2. https://www.coursera.org/learn/ Unix Sytem Programming
3. https://nptel.ac.in/courses/106107129/

Practice:

SL.NO	List of Programs
1	POSIX allows an application to test at compile or run time whether certain options are supported, or what the value is of certain configurable constants or limits.At compile time this is done by including <unistd.h> and/or <limits.h> and testing the value of certain macros. Write a C/C++ POSIX compliant program to check the following limits: (i) No. of clock ticks (ii) Max. no. of child processes (iii) Max. path length (iv) Max. no. of characters in a file name (v) Max. no. of open files/ process
2	File locking provides a very simple yet incredibly useful mechanism for coordinating file accesses.flock - manage locks from shell scripts.fcntl (used to manipulate the file descriptors) file commands can be used to support record locking, which permits multiple cooperating programs to prevent each other from simultaneously accessing parts of a file in error-prone ways.fcntl() performs the operations on the open file descriptor fd. Consider the last 100 bytes as a region. Write a C/C++ program to check whether the region is locked or not. If the region is locked, print pid of the process which has locked. If the region is not locked, lock the region with an exclusive lock, read the last 50 bytes and unlock the region.
3	Pipes are the oldest form of UNIX System IPC and are provided by all UNIX systems. Pipes have two limitations. 1. Historically, they have been half duplex (i.e., data flows in only one direction). Some systems now provide full-duplex pipes, but for maximum portability, we should never assume that this is the case. 2. Pipes can be used only between processes that have a common ancestor. Normally, a pipe is created by a process, that process calls fork, and the pipe is used between the parent and the child. A pipe is created by calling the pipe function. Write a C/C++ program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.
4	Environment variables are a set of dynamic named values that can affect the way running processes will behave on a computer.They are part of the operating environment in which a process runs. For example, a running process can query the value of the TEMP environment variable to discover a suitable location to store temporary files, or the HOME or USERPROFILE variable to find the directory structure owned by the user running the process. Write a C/C++ program that outputs the contents of its Environment list
5	Links are created by giving alternate names to the original file. The use of links allows a large file, such as a database or mailing list, to be shared by several users without making copies of that file. Not only do links save disk space, but changes made to one file are automatically reflected in all the linked files. The ln command links the file designated in the SourceFile parameter to the file designated by the TargetFile parameter or to the same file name in another directory specified by the TargetDirectory parameter. By default, the ln command creates hard links Write a C /C++ program to emulate the unixlncommand

6	A race condition occurs when multiple processes are trying to do something with shared data and the final outcome depends on the order in which the processes run. The fork function is a lively breeding ground for race conditions, if any of the logic after the fork either explicitly or implicitly depends on whether the parent or child runs first after the fork. In general, we cannot predict which process runs first. Even if we knew which process would run first, what happens after that process starts running depends on the system load and the kernel's scheduling algorithm Write a C/C++ program to illustrate the race condition.
7	In unix terminology, a process that has terminated, but whose parent has not yet waited for it, is called a zombie. Write a C/C++ program that creates a zombie and then calls system to execute the pscommand to verify that the process is zombie.
8	If we want to write a process so that it forks a child but we don't want to wait for the child to complete and we don't want the child to become a zombie until we terminate, the trick is to call fork twice. Write a C/C++ program to avoid zombie process by forking twice.
9	System () executes a command specified in command by calling /bin/sh -c command, and returns after the command has been completed. The exec () family of functions replaces the current process image with a new process image. The execl () function is one among the exec () family of functions. The waitpid () system call suspends execution of the calling process until a child specified by pid argument has changed state. Write a C/C++ program to implement the systemfunction.
10	First, every signal has a name. These names all begin with the three characters SIG .For example, SIGABRT is the abort signal that is generated when a process calls the abort function.SIGALRM is the alarm signal that is generated when the timer set by the alarm function goes off.Use the alarm API for generating a signal after certain time interval as specified by the user. Write a C/C++ program to set up a real-time clock interval timer using the alarmAPI.

Course Title	Mobile Application Development				Course Type		Integrated	
Course Code	M20TDS232	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	**0**	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

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:

CO#	Course Outcomes	Pos	PSOs
CO1	Analyse Android Platform, its architecture and features.	1,2,3,4,5	1,2,3
CO2	Design and implementation of user interface, database and content providers.	1,2,3,4,5	1,2,3
CO3	Make use of activities, layouts and Graphics in the development of apps for android	1,2,3,4,5	1,2,3
CO4	Evaluate multimedia, camera and location based services in Android application..	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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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.

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.

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.

JOURNALS/MAGAZINES:

1. Springer Journal on Mobile Networks and Applications
2. IEEE Journal on Multimedia and Applications
3. Elsevier Journal on Systems and Software

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_cs52/preview
2. https://www.classcentral.com/course/swayam-introduction-to-modern-application-development-7908
3. https://nptel.ac.in/courses/106/106/106106156/

PRACTICE:

Sl. No	List of Programs
1	Introduction to Android platform. Introduction to the tools used in the Android emulator. Create a simple application.
2	Create an Android UI with one text field, centered at the top of the screen, and one button. The text field display the text "**You tapped 0 times**" .For every user's tap the button, will increment a counter and update the text field accordingly.
3	Program a **"<username>DemoSuite**" app that allows a user to retrieve and display an internet resource (an xkcd cartoon), trigger a simple custom animation, play video, convert text to speech, and enter text via speech. The main structure that developer must follow is that of a "TabLayout + ViewPager" skeleton, and five different fragments that are started from tabs in the TabLayout. The five fragments will implement the above mentioned functionalities, and they can be tested individually, and need not interact with each other, other than being started from the same framework.
4	The Developer can use skeleton code to get started with the development. Unzip the file and rename the "BoilerPlateHW3" folder to **"<username>DemoSuite**", which can then import to Android Studio. Refactor this code to rename the package name to your usual package name, and the app name to **"<username>DemoSuite**" (as shown in class). The skeleton code displays a package name in the Activity's **onCreate method**. Include the code if app is created from scratch. The TAs will rely on this Toast while grading. Fragments are added, using Android Studio menu actions. The app must handle orientation switches from Portrait to Landscape and back. State should be saved in all cases. The video player should have a special landscape layout. When the app is opened for the first time it should display a view of the first tab (the xkcd viewer), with an empty page and a text field to enter a number and a send button.
5	RFID BASED AUTOMATIC TRAFFIC VIOLATION TICKETING The "Traffic Violation Ticketing Automation using RFID" can be used easily anytime, anywhere and ticket will be present in the customer's phone in the form of "RFID". GPS facility is used for validation of the ticket at the source and deletion at the destination. The main objective for this project is developing an android application so that passengers can book the tickets online directly from their smart phones and a received message to their own phones is enough for travelling a desired distance. Thus, the process of standing in lines to book the tickets and after that carrying the tickets is curdled. For security reasons the information about every user is stored in CLOUD which is to be accessed for each ticket booking for validation purpose. This change of paradigm benefits from the fact that cloud ticketing services can be accessed through the Internet and they can be elastically grown or shrunk, providing easier scalability and high availability. There are two modes of ticket payment. Firstly, a customer can pay using their wallet and secondly user can request ticket checker to load some amount in the wallet. The information for each user is stored in a SQL database for security purpose. Also the ticket checker is provided with an application to search for the user's ticket with the ticket number in the cloud database for checking purposes.

6	CHILD MONITORING SYSTEM APPLICATION PROJECT The application uses two main services that is GPS and telephonic services. For location services is GPS and telephony services is SMS, call logs and contacts. Android is a widely used OS used by a lot of masses globally. Internet is used for communicating between children and parent side. The System can be designed in a simple way. The application developed to make user-friendly approach on both sides. The parents and children both should have GPS Based smart phones. The application is used to track the Child's location as well as call logs, messages and contact from their smartphone. Reason for choosing android OS is that to target more users.
7	**ANDROID DABBAWALA PROJECT** This system is made with the view point of managing the Mumbai Dabbawala's who provide homemade food to the respective people working in an organization. With the help of this system the dabbawala can deliver the food at correct time. This system is developed in android where user can easily order their food with their hand held devices. As this system is developed in android user can easily use dabba service anywhere at anytime. This application is built to be beneficial to student knowledge as well as help Mumbai dabbawala's.This system allows the user to order the dabba service based on weekly, monthly or quarterly basis. System will calculate the cost based on the service user had selected. In this system android user can select dabba service or catering service. In dabba service he can get food delivered from his home by the dabbawala's at specified timing. In catering service he can order thali by mentioning certain details required for the dabbawala's such as food type, quantity, time etc. User can view the orders he had placed. User can make payment online by mentioning the details required for the payment. Admin can view order of various users. Admin can make dabba order as well as catering order in case user had informed through call. Admin can even view various user details. This system helps to manage the whole dabbawala system. This system helps to deliver food faster and at right time to the respective users.
8	ANDROID VOTING SYSTEM PROJECT This application provides is a new technique of casting votes using mobile phones. Android voting system is an application developed for android devices to deploy an easy and flexible way of casting votes anytime and from anywhere. The application is especially developed for organizations to get employees votes for any new policy regulation or issues. The issues or arguments are fed into the system by the admin. Employees can then cast their vote as yes or no. One voter can only post one vote for an argument. Each and every vote casted is stored in the database for the respective argument. At the end of the voting process the system counts the total votes and generates a brief report of it to the admin. Thus the app helps the company to get proper feedback of the employees
9	ANDROID VOTING SYSTEM PROJECT This application provides is a new technique of casting votes using mobile phones. Android voting system is an application developed for android devices to deploy an easy and flexible way of casting votes anytime and from anywhere. The application is especially developed for organizations to get employees votes for any new policy regulation or issues. The issues or arguments are fed into the system by the admin. Employees can then cast their vote as yes or no. One voter can only post one vote for an argument. Each and every vote casted is stored in the database for the respective argument. At the end of the voting process the system counts the total votes and generates a brief report of it to the admin. Thus the app helps the company to get proper feedback of the employees

10	CLASSROOM AUTOMATION USING ANDROID APP PROJECT In this Classroom Automation project, we are using an android app by which the user can select the classroom or group multiple classrooms to announce script, with this system human effort and time is reduced. Announcement from control room is captured with mic and feeded into the amplified box, from that amplifier box sound signal is sent into relay switching box, from relay switching box sound is switched into the respective classroom based on user inputs from android app.

<table>
<tr><td>Course Title</td><td colspan="4">Python for Data Analysis</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS233</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

Python has become one of the most popular dynamic, programming languages, along with Perl, Ruby, and others. Python and Ruby have become especially popular in recent years for building websites using their numerous web frameworks, like Rails (Ruby) and Django (Python). Among interpreted languages Python is distinguished by its large and active scientific computing community. Adoption of Python for scientific computing in both industry applications and academic research has increased significantly since the early 2000s.

Python's improved library support (primarily pandas) has made it a strong alternative for data manipulation tasks. Combined with Python's strength in general purpose programming, it is an excellent choice as a single language for building data-centric applications.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand Python, data structures, functions;
2. Demonstrate the knowledge on numpy and pandas for data analysis techniques;
3. Illustrate the use of concepts of Reading and Writing Data, data cleaning and preparation for data analysis;
4. Apply data wrangling and to plot and visualize data.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Understand the concepts of Python, data structures, functions;	1,2,3,4,5	1,2,3
CO2	Make use of inbuilt packages like numPy and pandas to perform operations on dataset	1,2,3,4,5	1,2,3
CO3	Experiment with various pre processing techniques for data analysis .	1,2,3,4,5	1,2,3
CO4	Apply data wrangling and to plot and visualize data.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT 1

Preliminaries: Why Python for Data Analysis?Essential Python Libraries.

Python Language Basics, IPython and Jupyter Notebooks: The python interpreter, IPython basics, Python language basics, built in Data Structures, functions and Files: Data srructures and sequences, Functions, Files and operating system

UNIT- 2

NumPy Basics: Arrays and Vectorized Computation: The NumPy ndarray: A Multidimensional Array Object, Universal Functions: Fast Element-wise Array Functions, Array oriented Programming with Arrays, File Input and Output with Arrays,

Getting started with pandas : Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics, Correlation and Covariance, Unique Values, Value Counts, and Membership

UNIT- 3

Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format, Interacting with HTML and Web APIs, Interacting with Databases.

Data Cleaning and Preparation: Handling missing data, Data Transformation, String Manipulation

UNIT- 4

Data Wrangling: Hierarchical indexing, Combining and Merging Datasets, Reshaping and pivoting.

Plotting and Visualization: Plotting using matplotlib, pandas and seaborn, other python visualization Tools.

SELF-LEARNING:

Advanced Numpy, Advanced Pandas, Data Aggregation

TEXT BOOKS:

1. Wes McKinny, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly Media, 2012.

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

1. Springer Journal on Python for Data Analysis
2. IEEE Transaction on Python for Data Analysis
3. Elsevier Journal on Python for Data Analysis

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Python for Data Analysis
2. https://www.classcentral.com/course/swayam- Python for Data Analysis
3. https://nptel.ac.in/courses/106/106/106106156/

PRACTICE

SL.NO	List of Programs
1	Anaconda is a free and open-sourcedistribution of the Python and R programming languages for data science, machine learning applications, large-scale data processing, predictive analytics, etc.. Anaconda makes package management and deployment very simple. Download and Install of Anaconda Distribution of Python, understanding of Jupyter Notebook and various menu items in it, importing modules like Pandas, Numpy, SciPy etc.
2	Data frames in Python Pandas are excellent objects to handle tabular data from various sources. Write a python program to demonstrate creation of data frame using various formats of input data
3	Any real time project involves data munging and data wrangling which involves selecting required rows and columns of data and manipulations on them. Write a python program to demonstrate following operations on rows and columns of a data frame: a. Selection b. Insertion c. Deletion
4	In order to explore the dataset and understand insights from it, the measures of central tendency play a crucial role, python has a strong set of functions that help you explore data. Write a python program to compute descriptive statistics for measures of central tendency from given data: - Mean, Geometric Mean, Harmonic Mean, Median, and Mode
5	Measuring descriptive statistics in data helps you decide what kind of processing to perform on it to gain useful information from data. Write a python program to compute descriptive Statistics for Measures of Variability from given data- Variance, Standard Deviation, Skew, Percentiles
6	Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. For example, height and weight are related; taller people tend to be heavier than shorter people. Write a python program to compute measures of Correlation in given data - using Pearson, Spearman correlation coefficients.
7	Data Visualization is visually representing the data using different plots/graphs/charts to find out the pattern, outliers, and relation between different attributes of a dataset. It is a graphical representation of data that helps human eye to detect patterns in data hence helps give a direction to data analysis tasks. Write a python program to plot following graphs using Matplotlib – Scatter plot, Box Plot, Bar Chart, Pie Chart
8	Often a data analyst needs to combine data in a data frame by some criteria. This is done by providing a label to group data in the table. The pandas functions allow us to merge as well group data along rows and columns as per various criteria. Write a python program to demonstrate following operations on two data frames: a. Merging b. GroupBy

9	Hypothesis testing is a core concept in inferential statistics and a critical skill in the repertoire of a data scientist. The t-test is statistical hypothesis test in which the test statistic follows a Student's t-distribution under the null hypothesis. It is applied for normally distributed test statistic. Write a python program to demonstrate Hypothesis testing using Student's T Test.
10	Regression is a technique for searching relationships among variables in data. E.g. trying to understand relationship between salary and experience in years for employees in a data set containing employee information. Linear regression involves relation between one dependent and one independent variable. Write a python program to apply simple linear regression on data

Semester – III

Syllabus

Course Title	Advanced Algorithms				Course Type	Theory	
Course Code	M20TD0301	Credits	3		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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:

1. Explain the problem solving methods and provide a solid foundation in algorithm design and analysis.
2. Discuss sorting & string matching algorithmic design paradigms.
3. Demonstrate a familiarity with major algorithms and data structures related to graph.
4. Design efficient algorithms for common engineering problems.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Apply iterative and recursive algorithms to model engineering problems in real world	1,2,3,4,5	1,2,3
CO2	Experiment with different sorting and string matching algorithms for real time data sets..	1,2,3,4,5	1,2,3
CO3	Analyse the search and graph algorithms for real world applications	1,2,3,4,5	1,2,3
CO4	Make use of Number Theoretic Algorithms and Probabilistic and Randomized Algorithms in real world applications.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Anany Levitin, “Introduction to the Design & Analysis of Algorithms”, Pearson, 2013
2. Ellis Horowitz, SartajSahni, S. Rajasekharan, “Fundamentals of Computer Algorithms”, 2nd Edition, Universities Press, 2007.
3. J. Kleinberg and E. Tardos, “Algorithm Design”, Addison Wesley, 2005.
4. V. Aho, J. E. Hopcraft, and J. D. Ullman, “Design and Analysis of Algorithms”, Addison-Wesley, 1974.

JOURNALS/MAGAZINES

1. IEEE Transactions on Advance Algorithms
2. Springer Journal of Advance Algorithms
3. Elsevier Journal of Advance Algorithms

SWAYAM/NPTEL/MOOCS:

1. https://www.udemy.com/ Advance Algorithms
2. https://www.coursera.org/learn/ Advance Algorithms
3. https://nptel.ac.in/courses/106106139/

Course Title	Internet of Things				Course Type	Integrated	
Course Code	M20TD0302	Credits	3		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	1	2	2	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**5**	**5**	**39**	**50**	**50**

COURSE OVERVIEW:

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:

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the foundation in the Internet of Things, including the components, tools, and analysis.	1,2,3,4,5	1,2,3
CO2	Apply Internet-of-Things and design principles in development of real-world applications.	1,2,3,4,5	1,2,3
CO3	Design prototypes forimplementingIoT in Big Data and understand the utilization and modelling of extracted data development of real-world application.	1,2,3,4,5	1,2,3
CO4	Develop embedded IoT Solutions using sensors and components integration for the real time application	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay audisetti, “Internet of Things - A Hands on Approach”, University Press, 2014.
2. Michael Millen, “The Internet of Things”, Pearson, 2015.

REFERENCE BOOKS:

1. Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, Wiley Publication, 2013
2. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers, 2013

JOURNALS/MAGAZINES

1. IEEE Transactions on Internet of Things
2. Springer Journal of Internet of Things
3. Elsevier Journal of Internet of Things

SWAYAM/NPTEL/MOOCS:

1. https://www.udemy.com/ Internet of Things
2. https://www.coursera.org/learn/ Internet of Things
3. https://nptel.ac.in/courses/106106133/

PRACTICE

SL.NO	List of Programs
1	There are lots of ways to control DC motors with an Arduino. But one of the easiest and most popular is with an L293D motor driver. The L293D motor driver is designed specifically to control DC motors, stepper motors, solenoids, and any other load with a high impedance. One of its main advantages is that it can control. Design and construct a module to drive DC motor clockwise and anti-clockwise using L293D with Arduino board.
2	Interfacing is the first step to create any useful project. So why don't we create an RFID based Access Control System or an RFID based Door Lock using Arduino? The system I have designed here is a simple version of the project. This project can be enhanced with a lot of features (which I will be doing in the next version of this project – Advanced RFID based Door Lock). Design and construct a module to build a RFID based Access Control System or an RFID based Door Lock using Arduino and display lock status on LCD.
3	The ESP8266 has been a growing star among IoT or WiFi-related projects. It's an extremely cost-effective WiFi module that – with a little extra effort – can be programmed to build a standalone web server. Design a module to control an LED from Webserver using NodeMcu or Esp8266 programming with Arduino IDE.
4	Most new cars today come with a host of advanced safety features including automated systems that assist the drive in maintaining control of the car and warning the driver of possible dangers. The problem, however, is that while these kinds of features greatly increase the safety of a car, they are exorbitantly expensive and only available in new, high-end cars not in old, low-end cars. Design a module for non-contact object detection using Arduino and proximity sensor (Car proximity alert).
5	To designing a intelligent "Graden Computer" with an optional digital plant moisture sensor/water pump controller that lights an LED to alert the user when it is time to water a potted plant, and/or turn on a water pump to quench the thirst, here is an Arduino Primer for you. No doubt, an Arduino can convert your favorite pots into self-watering planters, keeping your plants from drying out and reducing the time you spend watering. Design an intelligent Garden Computer with Arduino and soil moisture sensor that lights an LED to alert the user when it is time to water a potted plant.
	PART-B (IoT Projects)
6	The Arduino Yun solves that problem. The Yun is an Arduino with WiFi built in. Additionally, the Yun has a second microprocessor that runs a lightweight version of Linux and comes with Python preinstalled. This means that for $75, you can have sensors and buttons trigger Python scripts, and Python scripts trigger LEDs, motors and other actuators. And Python's just the language that comes with it — you can install Ruby, Node or PHP if that's your jam. Set up ArduinoYún to connect to WiFi
7	To control your room's temperature, we can build a smart temperature controller. In this case, we use a **PID** (**proportional–integral–derivative**) controller. When you set a certain temperature, a PID controller will change the temperature by turning either cooler or hotter. A PID controller program is developed using Python, which runs on the Raspberry Pi board. Build a smart temperature controller for your room
8	Dedicated control over room temperature is not only a key issue in providing work conditions that ensure employee satisfaction and hence increased work output; it is now a health and safety issue. The design considered the flexibility of using a microcontroller, PIC16F876A along with other peripheral devices such as LM35 temperature sensor, LCD display unit to form all-encompassing single system Build your own decision system based-IoT
9	Tracking multiple objects through video is a vital issue in computer vision. It's used in various video analysis scenarios, such as visual surveillance, sports analysis, robotic navigation, autonomous driving, human-computer interaction, and medical visualization. In cases of monitoring objects of a certain category, such as people or cars, detectors used to make tracking easier. Usually, it is done in two steps: Detecting and Tracking. Build a tracking vision system for moving objects
10	The robot constantly checks to see if it is within 0 meters of the GPS position, if it is then the App display will read "Destination Reached". As you can see sometimes it returns to the correct location and other times it is several feet off. Build a your own car robot based on GPS

<table>
<tr><td>Course Title</td><td colspan="3">Python for Artificial Intelligence</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TD0303</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course is an introduction to basic concepts of various fields of artificial intelligence like Artificial Neural Networks, Natural Language Processing, Machine Learning and its implementation in Python.

COURSE OBJECTIVES:

The objectives of this course are to

1. Explain the Basics concepts of Python and Artificial Intelligence.
2. Build an Intelligent Agent using AI concepts.
3. Develop a sentiment analyzer using python.
4. Illustrate the Concepts of Reinforcement Learning.

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate fundamental understanding of artificial intelligence (AI) and python.	1,2,3,4,5	1,2,3
CO2	Apply basic principles of AI to solve real world applications.	1,2,3,4,5	1,2,3
CO3	Make use of AI principles to design a Speech recognizer.	1,2,3,4,5	1,2,3
CO4	Make use of python to Implement Q-Learning algorithm.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT1

Python Basics: Introducing Python, Variables and Data Types, Making Choices, Using Lists, Functions, Working with Text, Executable Files.

Introduction to Artificial Intelligence: What is Artificial Intelligence?, Why do we need to study AI?, Applications of AI, Branches of AI, Defining intelligence using Turing Test, Making machines think like humans, Building rational agents, General Problem Solver, Solving a problem with GPS, Building an intelligent agent, Types of models,

UNIT 2

Natural Language Processing: Introduction and installation of packages, Tokenizing text data, Converting words to their base forms using stemming, Converting words to their base forms using lemmatization, Dividing text data into chunks, Extracting the frequency of terms using a Bag of Words model, Building a category predictor, Constructing a gender identifier, Building a sentiment analyzer, Topic modeling using Latent Dirichlet Allocation, Summary.

UNIT3

Probabilistic Reasoning for Sequential Data: Understanding sequential data, Handling time-series data with Pandas, Slicing time-series data, Operating on time-series data, Extracting statistics from time-series data, Generating data using Hidden Markov Models, Identifying alphabet sequences with Conditional Random Fields, Stock market analysis, Summary.

Building A Speech Recognizer: Working with speech signals, Visualizing audio signals, Transforming audio signals to the frequency domain, Generating audio signals, Synthesizing tones to generate music, Extracting speech features, recognizing spoken words, Summary.

UNIT4

Reinforcement Learning: Understanding the premise, Reinforcement learning versus supervised learning, Real world examples of reinforcement learning, Building blocks of reinforcement learning, creating an environment, Building a learning agent, Summary.

SELF –LEARNING COMPONENTS

Artificial neural networks, Machine Learning Techniques

TEXT BOOKS:

1. Tim Hall and J-P Stacey, “Python 3 for Absolute Beginners”, Apress, 2009.
2. Prateek Joshi, “Artificial Intelligence with Python”, First edition, Packt publishers, 2017.

REFERENCE BOOKS:

1. Stuart Jonathan Russell, Peter Norvig, “Artificial Intelligence for Dummies”, Dummy Series.

JOURNALS/MAGAZINES:

1. Elsevier Journal of Artificial Intelligence
2. IEEE Transactions on Artificial Intelligence
3. Springer Jounal of Artificial Intelligence

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/Artificial intilligence/
2. https://www.coursera.org/learn/machine-learning
3. https://nptel.ac.in/courses/106106139/

PRACTICE:

Sl.No.	List of programs
1	Machine learning algorithms expect data to be formatted in a certain way before they start the training process. In order to prepare the data for ingestion by machine learning algorithms, we have to preprocess it and convert it into the right format. Apply the following preprocessing techniques on the given data set i) Binarization ii) Normalization iii) Mean removal iv) Scaling The dataset is available in the following website. https://github.com/PacktPublishing/Artificial-Intelligence-with-Python.
2.	Naïve Bayes is a technique used to build classifiers using Bayes theorem. Bayes theorem describes the probability of an event occurring based on different conditions that are related to this event. Build an Naïve Bayes classifier to classify an animal to Cheetah assuming the attributes.
3.	A Support Vector Machine (SVM) is a classifier that is defined using a separating hyperplane between the classes. This hyperplane is the N-dimensional version of a line. Given labeled training data and a binary classification problem, the SVM finds the optimal hyperplane that separates the training data into two classes. Build a Support Vector Machine classifier to predict the income bracket of a given person based on 14 attributes. Our goal is to see where the income is higher or lower than $50,000 per year. The income dataset available at https://archive.ics.uci.edu/ml/datasets/Census+Income.
4	Regression is the process of estimating the relationship between input and output variables. Regression analysis helps us in understanding how the value of the output variable changes when we vary some input variables while keeping other input variables fixed. Build a regression model for a single variable for any given Dataset.
5	A **Decision Tree** is a structure that allows us to split the dataset into branches and then make simple decisions at each level. This will allow us to arrive at the final decision by walking down the tree.Build a classifier using Decision Trees in Python.
6	Clustering is one of the most popular unsupervised learning techniques. This technique is used to analyze data and find clusters within that data. In order to find these clusters, we use some kind of similarity measure such as Euclidean distance, to find the subgroups. This similarity measure can estimate the tightness of a cluster. Apply K-Means clustering on two-dimensional data and analyze the data.
7	Apply unsupervised learning techniques to segment the market, based on customer shopping habits.
8	Build a model to find the relationship between the family members using logic programming.
9.	Build a python program **Predicting traffic** using Extremely Random Forest regressor.
10	Sentiment analysis is the process of determining the sentiment of a given piece of text Build a sentiment Analyzer using NLp concepts to determine whether a movie review is positive or negative.

Course Title	Mini Project				Course Type	Practice	
Course Code	M20TD0304	Credits	2		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**2**	**4**	**4**	**26**	**50**	**50**

COURSE OVERVIEW:

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 OBJECTIVE (S):

1. To create an Industrial environment and culture within the department of CSE.
2. To provide students hands on experience on, troubleshooting, maintenance, innovation, record keeping, documentation etc thereby enhancing the skill and competency part of technical education.
3. To promote the concept of entrepreneurship.
4. To inculcate innovative thinking and thereby preparing students for main project.

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic.	7 to 11	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	7 to 11	1,2,3
CO3	Design solutions to the chosen project problem.	7 to 11	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	7 to 11	1,2,3
CO5	Use the appropriate techniques, resources and modern engineering tools necessary for project work.	7 to 11	1,2,3

CO6	Apply project results for sustainable development of the society.	7 to 11	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7 to 11	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	7 to 11	1,2,3
CO9	Function effectively as individual and a member in the project team.	7 to 11	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	7 to 11	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	7 to 11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√	√	√	
CO2			√	√	√	
CO3			√	√	√	
CO4			√	√	√	
CO5			√	√	√	
CO6			√	√	√	
CO7			√	√	√	
CO8			√	√	√	
CO9			√	√	√	
CO10			√	√	√	
CO11			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3	3	3	3	3	3	3	3

CO2							3	3	3	3	3	3	3	3
CO3							3	3	3	3	3	3	3	3
CO4							3	3	3	3	3	3	3	3
CO5							3	3	3	3	3	3	3	3
CO6							3	3	3	3	3	3	3	3
CO7							3	3	3	3	3	3	3	3
CO8							3	3	3	3	3	3	3	3
CO9							3	3	3	3	3	3	3	3
CO10							3	3	3	3	3	3	3	3
CO11							3	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The following are the guidelines to be followed by the students to complete their research based mini projects.

1. The students can select their guides based on their area of interest in their previous semester.
2. In the beginning of the current semester the students shall corner the problem by performing the literature survey (by choosing the research papers of reputed Journals) in their area of interest.
3. The students shall choose a base paper from the list of papers they would have surveyed.
4. The students shall identify the research gaps in their selected research domain, and finalize their problem statement with objectives for the research based mini project.
5. The students shall be completing the synopsis presentation (phase-1 presentation (progress)), and phase-2 presentation (implementation with demo) as per the calendar set by the concerned coordinator.
6. Finally, the students shall complete their mini projects providing innovative solutions for the selected research problem and apply for patent / copyright / paper publication in SCOPUS indexed journals / research proposals / product development / and or startups.

COURSE CONTENTS:

Sample Mini Projects:

1. Doorbell Cum Visitor Indicator

This doorbell cum visitor indicator circuit can give identification of the visitor to your home in your absence.

2. Electronic Fuse

An absolute necessity of every electronics lab is a workbench power supply. The power supply should be regulated and protected against short circuit. Most power-supply protection circuits use a low-value, high-wattage resistor

connected in series with the load for current sensing. The voltage drop across the sensor resistor is weighed to activate the protection circuit. The given electronic fuse circuit is based on a poly-fuse application, which is a re-settable fuse by itself.

3. Sonar Water Level Meter

This project helps you in designing a water level meter to check up on the amount of water in the tank. Earlier systems used metal which got rusted over time. Whereas this next system is contactless resulting in no such problems.

4. Fire sensor

This mini project is an ultra-sensitive fire sensor that activates an alarm when it detects fire. Thermistor based fire alarms work well when the thermistor is in close vicinity. In this circuit, a sensitive PIN diode is used as a fire sensor for longer-range fire detection.

5. Thermostat For Fridge

A thermostat is standard equipment for sensing the temperature of a system and maintaining it at a pre-defined point. It is a regular feature in air-conditioners, room heaters and refrigerators. Although some refrigerators have inbuilt thermostats, the given system automatically turns on or turns off the appliance at pre-set temperatures.

SEMESTER – IV

SYLLABUS

Course Title	High Performance Computing				Course Type		Integrated	
Course Code	M20TDS411	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	4	5	5	39	26	50	50

COURSE OVERVIEW:

The goal of this course is to give students solid foundations for developing, analyzing, and implementing parallel and locality-efficient algorithms. This course focuses on theoretical underpinnings. To give a practical feeling for how algorithms map to and behave on real systems and will supplement algorithmic theory with hands-on exercises on modern HPC systems, such as Cilk Plus or OpenMP on shared memory nodes, CUDA for graphics co-processors (GPUs).

COURSE OBJECTIVES:

The objectives of the course are:

1. Explain the basics of processors and parallel computing
2. Discuss the different models of parallel systems.
3. Demonstrate Shared-memory parallel programming with OpenMP for real world Applications
4. Describe the fundamental Distributed-memory parallel programming with MPI.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Summarize the basics of processors and parallel computing	1,2,3,4	1,2,3
CO2	Apply the different models of parallelism to real world applications.	1,2,3,4	1,2,3
CO3	Develop Shared-memory parallel programming with OpenMP for real world Applications	1,2,3,4	1,2,3
CO4	Make use of the concepts of fundamental Distributed-memory parallel programming with MPI.	1,2,3,4	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

Modern Processors: Stored-program computer architect; General-purpose cache-based microprocessor architecture; Memory hierarchies; Multicore processors; multithreaded processors; Vector processors.

Parallel computers: Taxonomy of parallel computing paradigms; Shared-memory computers; Distributed-memory computers; Hierarchical (hybrid) systems; Networks.

UNIT -2

Basics of parallelization: Why parallelize; Parallelism; Parallel scalability.

UNIT-3

Shared-memory parallel programming with OpenMP: Introduction to OpenMP; Case study: OpenMP-parallel Jacobi algorithm; Advanced OpenMP: Wavefront parallelization.

Efficient OpenMP programming: Profiling OpenMP programs; Performance pitfalls; Case study: Parallel sparse matrix-vector multiply.

UNIT-4

Distributed-memory parallel programming with MPI: Message passing; a short introduction to MPI; Example: MPI parallelization of a Jacobi solver.

Efficient MPI programming: MPI performance tools; Communication parameters; Synchronization, serialization, contention; Reducing communication overhead; Understanding intranode point-to-point communication.

SELF-LEARNING COMPONENT:

More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

TEXT BOOKS:

1. Introduction to High Performance Computing for Scientists and Engineers, Georg Hager, Gerhard Wellein, CRC Press, CRC Press,2011.

REFERENCE BOOKS:

1. Rohit Chandra , Leo Dagum , DrorMaydan , David Kohr, Jeff McDonald , Ramesh Menon, “Parallel Programming in OpenMP”, 2nd edition, Addison-Welsey, © 2003.
2. Shameem Akhter and Jason Roberts, “Multi-core programming, Increase performance through software multhreading”
3. Kai Hwang ,”Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill 1993
4. George S. Almasi and Alan Gottlieb, “Highly Parallel Computing”, 2nd edition, Addison-Welsey, © 2003.
5. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, “Introduction to Parallel Computing”, 2nd edition, Addison-Welsey, © 2003.

JOURNALS/MAGAZINES:

1. Springer Journal on High Performance Computing
2. Elsevier Journal on High Performance Computing
3. IEEE Transactions on Knowledge and Data Engineering.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ High Performance Computing
2. https://www.classcentral.com/course/ High Performance Computing
3. https://nptel.ac.in/courses/106/106/106106156/

PRACTICE:

SL.NO	List of Programs
1	Program which is composed of three parts executed consecutively: 1. A part which you can not parallelize, responsible for a fraction α1 = 0.01 of the total running time. 2. A part which you can parallelize with only 2 processors. This part is responsible for α2 = 0.04 of the time. 3. A part that can be parallelizable with many processors, occupying the remaining time of the program execution. According to the above information, what maximum speedup can you achieve, if you had no limitations on the number of processors n? How many processors do you need to obtain a speedup of at least 8?
2	Determine the asymptotic bounds on the operational intensity I(n) for the following matrix/vector operations, where n is the dimension of the vector. State your assumptions. 1. DAXPY: y = αx + y α ∈ R; x, y ∈ R n , double precision, 2. SGEMV: y = Ax + y x, y ∈ R n ; A ∈ R n×n , single precision, 3. DGEMM: C = AB + C A, B, C ∈ R n×n , double precision. **Hint: Assume that A, B and C fit into the cache at the same time**
3	Write a program that calculates the sum of numbers from 1 to 1000 in a parallel fashion while executing on all the cluster nodes and providing the result at the end on only one node. It should be noted that the print statement for the sum is only executed on the node that is ranked zero (0) otherwise the statement would be printed as much time as the number of nodes in the cluster.
4	Write an MPI code where array on each process is created. Initialize it on process 0. Once the array has been initialized on process 0, then send it out to each process.
5	Implement and demonstrate the sharing of work among threads in an OpenMP program. using 'Sections Construct'
6	Non-blocking point-to-point operation allows overlapping of communication and computation to use the common parallelism in modern computer systems more efficiently. This enables the user to use the CPU even during ongoing message transmissions at the network level. Demonstrate the understanding of MPI Non-Blocking operation.
7	Sequential simulations frequently use a single random number generator. What must a parallel simulation do in this context? Some desirable properties are: 1. Each worker process must draw from a distinct random number sequence. 2. Repeatability between parallel runs when using the same random seed. 3. Repeatability in comparing a parallel run with n slaves and a parallel run with only 1 slaves, when using the same random seed. 4. Repeatability between the parallelized simulation and the original (unmodified) sequential simulation.
8	For this exercise study basic MPI functions such as: For MPI management MPI_Int(),MPI Final() Each MPI program should start with MPI_Int and finish with MPI_Final() Each process can fetch the number of processes in the default communicator MPI_COMM_WORLD (the application) by calling MPI_Comm_size Process in a MPI application are identified by so called ranks ranging from 0 to n-1 where n is the number of processs returned by MPI_Comm_size(). Based on the rank each process can perform a part of all required computations so that all process contribute to final goal and process all required data.
9	For Point-to-point communication: MPI-Send(), MPI_Recv() Int MPI_Send(void * buf, int count,MPI_Datatype dtype, int dest, int tag, MPI_Count(comm) MPI_Send sends data pointed by buf to process with with rank dest. There should be count elements of data type dtype. For instance, when sending 5 doubles, count should be 5 and dtype should be MPI_DOUBLE tag can be any number which additionally describe thwe message and comm. Can be MPI_COMM-WORLD for the default communications. Int MPI_ Recv(void *buf , int count, MPI_Datatype dtype Int src, int tag, MPI_Comm comm., MPI-Status *star) MPI-Recv is a blocking receive which waits for message with tag from process with rank src in communicator comm. Dtype and count denote the type and the number of elements which are to be received and stored in buf. Stat holds information about the received message.
10	For collective communication MPI_Barrier (), MPI_Gather(), MPI_Scatter(),MPI_Allgather() As an example : Int MPI_Reduce(void *sbuf, void * rbuf, int count MPI_Datatype dtype, MPI_Op op, int root MPI_Comm comm)

	Reduce all values given by processes in communicator comm to a single value in process with rank root. See the code below for adding numbers given by all process to a single value in process 0

Course Title	Program Analysis				Course Type		Integrated	
Course Code	M20TDS412	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	**0**	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

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:

CO#	Course Outcomes	Pos	PSOs
CO1	Summarize the basic concepts of data flow analysis and common properties of variables and expressions.	1,2,3,4,5	1,2,3
CO2	Apply graph properties to data flow analysis, framework, assignments, functions and equations.	1,2,3,4,5	1,2,3
CO3	Design data flow analysis algorithm in round robin and iterative methods.	1,2,3,4,5	1,2,3
CO4	Develop various data flow analysis algorithms using the concept of GCC.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

1. Springer Journal on Program Analysis
2. IEEE Transaction on Program Analysis
3. Elsevier Journal on Program Analysis

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Program Analysis
2. https://www.classcentral.com/course/ Program Analysis
3. https://nptel.ac.in/courses/106/266/106106156/

PRACTICE:

Use any of the following programming languages Java, C++, C# and Python to implement the list of following programming task and use any of the following tools to analyze the code developed by you.

SL.NO	List of Tools
1	PVS-Studio: PVS-Studio is a tool for detecting bugs and potential vulnerabilities in the source code of programs written in C, C++, C#, or Java, and is also a Static Application Security Testing (SAST) tool. It is meant to be used as part of the CI practice and allows the user to detect bugs at the earliest development stages, where they cost almost nothing to fix.
2	Kiuwan: Automatically scan your code to identify and remediate vulnerabilities. Compliant with the most stringent security standards, such as OWASP and CWE, Kiuwan Code Security covers all important languages and integrates with leading DevOps tools.
3	Embold: Embold is a static analysis platform that offers AI-assisted code testing that not only identifies weak code and vulnerabilities, but also suggests solutions to rectify them.
4	CodeScene Behavioral Code Analysis: CodeScene is different from the traditional code analysis tools you might have come across earlier. So follow along as we explain how you use the analysis information and how you integrate CodeScene in your organization's daily work to get the most out of the tool.
5	Visual Expert: Visual Expert is a static program analyzer, extracting design and technical information from software source code by reverse-engineering, used by programmers for software maintenance,[1] modernization[2] or optimization.
6	Veracode: The Veracode REST and XML APIs mirror the major steps you complete on the Veracode Platform, automating the scanning, reviewing, mitigating, and administrative tasks.
7	Fortify Static Code Analyzer: Fortify Static Code Analyzer Fortify SCA is a **static application security testing** (SAST) offering used by development groups and security professionals to analyze the source code for security vulnerabilities. It reviews code and helps developers identify, prioritize, and resolve issues with less effort and in less time.
8	Parasoft: ParasoftSOAtest is a Web API Automation tool that makes use of two services i.e. SOAP and REST to perform Functional, Regression, Unit Testing, Runtime error detection, static code analysis, service virtualization
9	Coverity: Coverity is a **proprietary static code analysis tool** from Synopsys. This product enables engineers and security teams to find and fix software defects.
10	CodeSonar: CodeSonar is a **static code analysis tool** from GrammaTech. CodeSonar is used to find and fix bugs and security vulnerabilities in source and binary code. It performs whole-program, inter-procedural analysis with abstract interpretation on C, C++, C#, Java, as well as x86 and ARM binary executable and libraries.

SL.NO	List of Programs
1	Develop a program to multiply two given matrices of any order.
2	Create a program that would simulate stack operations.
3	Create a program that would simulate Queue operations.
4	Develop a program code to create and traverse a binary search tree.
5	Create a code to sort a list of items in ascending order, use merge sort logic.
6	Program to implement linear and binary search.
7	Develop a code to solve 0-1 Knapsack Problem
8	Create a code to implement dijkstra's algorithm.
9	Develop a code to solve the N Queens problem
10	Program to find all Permutations of a given string

<table>
<tr><td>Course Title</td><td colspan="4">Blockchain Technology</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS413</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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:

CO#	Course Outcomes	POs	PSOs
CO1	Describe the usage of block chain in terms of the underlying technology	1,2,3,4,5	1,2,3
CO2	Make use of Hyperledger to build applications on blockchain	1,2,3,4,5	1,2,3
CO3	Explore working of the bit coin	1,2,3,4,5	1,2,3
CO4	Implement new ways of using blockchain for applications in various aspects	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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

TEXT BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016
2. Mastering Bitcoin by Andreas Antonopoulos, https://github.com/bitcoinbook/bitcoinbook

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

1. Springer Journal on Blockchain Technology
2. IEEE Transaction on Blockchain Technology
3. Elsevier Journal on Blockchain Technology

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Blockchain Technology
2. https://www.classcentral.com/course/ Blockchain Technology
3. https://nptel.ac.in/courses/106/266/106106156/

PRACTICE:

SL.NO	List of Programs
1	Remix: Develop Smart Contracts for the EthereumBlockchain. Remix is a Solidity IDE that's used to write, compile and debug Solidity code. Solidity is a high-level, contract-oriented programming language for writing smart contracts. It was influenced by popular languages such as C++, Python and JavaScript. Develop your first program that prints "Hello Blockchain" using the remix sandbox for Etherium.
2	Hyperledger Fabric is an enterprise-grade, distributed ledger framework that aims to provide two core features for Blockchain use cases – modularity and versatility. Configure your machine and development environment to run hyper ledger fabric programs and test the set up by writing a program that computes squares of input numbers.
3	The blockchain is an innovative technology that overcomes these threats and allows to decentralize sensitive operations while preserving a high level of security. It eliminates the need for trusted intermediaries. The blockchain is accessible to all network nodes and keeps track of all transactions already made. Write a program that enables a user to send a signed message to other user on blockchain.
4	All transactions are recorded on the blockchain network and rely on user verification to be fully authenticated. The transactions executed during a given period of time are recorded into files Write a program that retrieves transaction details associated with a specific block on the chain.
5	Step-by-step guide to building a smart contract on Ethereum Step #1: Introducing two parties to an Ethereum smart contract Step #2: Enabling a client to transfer money to a smart contract Step #3: Allowing a smart contract to transfer money to a tasker Step #4: Deploying your smart contract Write a program to demonstrate how to deploy a blockchain smart contract.
6	A block chain is an application of cryptographic functions, namely hash functions, to create a system where participants are discouraged from behaving "bad". Simulate a simple blockchain in python – demonstrating mining, transaction, communication between nodes.
7	Instead of having a network, a central server, and a database, *the blockchain is a network and a database all in one*. A blockchain is a peer-to-peer network of computers, called nodes that share all the data and the code in the network. Write a program to simulate simplified steps in decentralized election process.
8	Blockchain also has other applications outside the world of cryptocurrencies, including copyright law, anti-piracy practices, and automated cash transfers. As long as distrust exists in the world, there will be a purpose for blockchain. Write a program to simulate creation your own crypto currency and demonstrate its usage in a transaction.
9	Supply chain is happening all around you. If your company somehow makes a product, or procures a product, or procures then makes a product that you then sell to a customer, you have an end-to-end supply chain that might need optimizing. Write a program to simulate agricultural supply chain from farmer to end customer.
10	Blockchain Firm is primarily aimed at resolving the current issues prevailing in the electronic commerce line of businesses. We leverage your enterprises by boosting blockchain e-commerce platforms. Our trending and innovative ideas aid you in incorporating this profitable tech into your business. Write a program to create a very basic e-commerce platform for trading.

<table>
<tr><td>Course Title</td><td colspan="4">Robotic Process Automation</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M20TDS421</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">IV Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Make use of recording features in UiPath Studio to automate the repetitive tasks.	1,2,3,4,5	1,2,3
CO2	Apply appropriate Workflow Activities in UiPath Studio to automate the complex tasks using Flowchart and Sequence.	1,2,3,4,5	1,2,3
CO3	Build data table and data manipulation techniques in UiPath Studio to automate CSV / Excel workbook applications	1,2,3,4,5	1,2,3
CO4	Design and Develop bot process using UI Explorer and Automate using Screen Scraping for applications in	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATION MATRIX

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

COURSE CONTENT:

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

TEXT BOOKS:

1. Alok Mani Tripathi Kindle, “Learning Robotic Process Automation” 2nd Edition, Packt Publishing, 2018

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

REFERENCE BOOKS:

1. Marlon Dumas et. al., “Fundamentals of Business Process Management”, Springer, e-book, 2012.

2. Van der Aalst, “Process Mining: Discovery, Conformance and Enhancement of Business Processes”, Third edition, 2011.

JOURNALS/MAGAZINES:

1. Springer Journal on Robotic Process and Automation
2. IEEE Transaction on Robotic Process and Automation
3. Elsevier Journal on Robotic Process and Automation

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Robotic Process and Automation
2. https://www.classcentral.com/course/ Robotic Process and Automation
3. https://nptel.ac.in/courses/106/266/106106156/

Course Title	Agile software development				Course Type	Theory	
Course Code	M20TDS422	Credits	3		Class	IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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:

1. Explain the basics of Agile Software Development and Software Development Rhythms.
2. Demonstrate the unique features related to traditional agile software practices.
3. Describe the core principles of a DevOps implementation and culture.
4. 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:

CO#	Course Outcomes	Pos	PSOs
CO1	Develop applications using traditional Agile Software practices	1,2,3,4,5	1,2,3
CO2	Outline the fundamental principles and practices of Agile Software in real world problem	1,2,3,4,5	1,2,3
CO3	Analyze the agile principles and values to a given situation.	1,2,3,4,5	1,2,3
CO4	Make use of Building Blocks of DevOps methods in real world problems.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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.

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/).

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.

JOURNALS/MAGAZINES:

1. Springer Journal on Agile Software Development
2. IEEE Transaction on Agile Software Development
3. Elsevier Journal on Agile Software Development

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Agile Software Development
2. https://www.classcentral.com/course/ Agile Software Development
3. https://nptel.ac.in/courses/188/255/106106156/

Course Title	Deep Learning				Course Type	Theory	
Course Code	M20TDS423	Credits	3		Class	IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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:

The objectives of this course are to:

1. Illustrate the use of Mathematical model for a real world application.
2. Explain learning algorithm for a real world application.
3. Demonstrate the deep learning neural network in a real world application.
4. Discuss the deep learning techniques in neural networks and natural language processing

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of mathematics to solve problems based on deep learning concepts.	1,5	1,3
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	2,3	2,3
CO3	Utilize deep learning neural network model on real time applications like(face recognition, speech recognition)	1,2	1,2,3
C04	Apply object detection and recognition techniques to solve real world problems.	3,5	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of mathematics to solve problems based on deep learning concepts.	1,2,3,4,5	1,2,3
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	1,2,3,4,5,8	1,2,3
CO3	Utilize deep learning neural network model on real time applications like(face recognition, speech recognition)	1,2,3,4,5,8	1,2,3
C04	Apply object detection and recognition techniques to solve real world problems.	1,2,3,4,5	1,2,3

COURSE ARTICULATIONMATRIX

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

CO2	2	3	3	2	1			1				2	3	3
CO3	3	3	1	2	2			1				3	3	3
CO4	2	1	3	2	3							3	3	2

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.

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.

REFERENCES:

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.

JOURNALS/MAGAZINES:

1. Springer Journal on Deep Learning
2. IEEE Transaction on Deep Learning
3. Elsevier Journal on Deep Learning

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Deep Learning
2. https://www.classcentral.com/course/ Deep Learning
3. https://nptel.ac.in/courses/106/266/106106156/

Course Title	Cyber Security Lab				Course Type	Practice	
Course Code	M20TD0403	Credits	2		Class	IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4		CIE	SEE
	-	**0**	-	-			
	Total	**2**	4	4	**26**	**50**	**50**

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Implement the cipher techniques	1,2,3,4,5,10	1,2,3
CO2	Develop the various security algorithms	1,2,3,4,5,9	1,2,3
CO3	Design different open source tools for network security and analysis	1,2,3,4,5,10	1,2,3
CO4	Demonstrate intrusion detection system using various open tools	1,2,3,4,5,10,11	1,2,3

COURSE ARTICULATIONMATRIX

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

Practice:

Sl. No.	**List of Program**
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
2	Implement the following algorithms a) DES b) RSA Algorithm c) Diffiee-Hellman d) MD5 e) SHA-1
3	Implement the Signature Scheme - Digital Signature Standard
4	Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG)
5	Setup a honey pot and monitor the honeypot on network (KF Sensor)
6	Installation of rootkits and study about the variety of options
7	Perform wireless audit on an access point or a router and decrypt WEP and WPA. (Net Stumbler)
8	Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w)

Course Title	Mini Project				Course Type	Practice	
Course Code	M20TD0404	Credits	2		Class	IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	0	-	-			
	Total	**2**	**4**	**4**	**26**	**50**	**50**

COURSE OVERVIEW:

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 OBJECTIVE (S):

1. To create an Industrial environment and culture within the department of CSE.
2. To provide students hands on experience on, troubleshooting, maintenance, innovation, record keeping, documentation etc thereby enhancing the skill and competency part of technical education.
3. To promote the concept of entrepreneurship.
4. To inculcate innovative thinking and thereby preparing students for main project.

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic.	7 to 11	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	7 to 11	1,2,3
CO3	Design solutions to the chosen project problem.	7 to 11	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	7 to 11	1,2,3

CO5	Use the appropriate techniques, resources and modern engineering tools necessary for project work.	7 to 11	1,2,3
CO6	Apply project results for sustainable development of the society.	7 to 11	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7 to 11	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	7 to 11	1,2,3
CO9	Function effectively as individual and a member in the project team.	7 to 11	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	7 to 11	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	7 to 11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√	√	√	
CO2			√	√	√	
CO3			√	√	√	
CO4			√	√	√	
CO5			√	√	√	
CO6			√	√	√	
CO7			√	√	√	
CO8			√	√	√	
CO9			√	√	√	
CO10			√	√	√	
CO11			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3	3	3	3	3	3	3	3

CO2							3	3	3	3	3	3	3	3
CO3							3	3	3	3	3	3	3	3
CO4							3	3	3	3	3	3	3	3
CO5							3	3	3	3	3	3	3	3
CO6							3	3	3	3	3	3	3	3
CO7							3	3	3	3	3	3	3	3
CO8							3	3	3	3	3	3	3	3
CO9							3	3	3	3	3	3	3	3
CO10							3	3	3	3	3	3	3	3
CO11							3	3	3	3	3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The following are the guidelines to be followed by the students to complete their research based mini projects.

1. The students shall form groups (max 4) and select their guides based on their area of interest in their previous semester.
2. In the beginning of the current semester the students shall corner the problem by performing the literature survey (by choosing the research papers of reputed Journals) in their area of interest.
3. The students shall choose a base paper from the list of papers they would have surveyed.
4. The students shall identify the research gaps in their selected research domain, and finalize their problem statement with objectives for the research based mini project.
5. The students shall be completing the synopsis presentation (phase-1 presentation (progress)), and phase-2 presentation (implementation with demo) as per the calendar set by the concerned coordinator.
6. Finally, the students shall complete their mini projects providing innovative solutions for the selected research problem and apply for patent / copyright / paper publication in SCOPUS indexed journals / research proposals / product development / and or startups.

COURSE CONTENTS

A mini project is an assignment that student try to complete at the end of every semester, especially in engineering to strengthen the understanding of your fundamentals through effective application of theoretical concepts. There are separate credits for each mini project you complete at college although I have seen many students taking up a project out of their own interest and passion. Mini project can help you boost your skills and widen your horizon of your thinking.

Mini projects form a middle ground for all segments of electronics engineers looking to build. Students work on various mini project ideas topics to improve their skills, whereas hobbyists like the fun in meddling with technology.

Mini project is based on small scale which can benefit the society or any organization on a small scale. Students work on various mini project ideas topics to improve their skills, whereas hobbyists like the fun in meddling with technology. Mini projects form a middle ground for all segments of electronics engineers looking to build.

SAMPLE MINI PROJECTS:

Consider a mini project that includes work in most disciplines, ending in a stable executable for a 3-week iteration (any example of software/hardware project of candidate choice). Construct a disciplines across iterations diagram considering the sample disciplines i.e., Requirements, Design, Implementation and Test.

1. Make Your Own Dual-Voltage Rechargeable Torch Light Line Follower
The purpose of this circuit is to create a new topology with good power factor maintained at AC voltage input, to provide good efficiency output to the battery and to increase its life.

2. GPS On ATmega
This electronics mini project idea might be something to get your hands on. Based on ATmega 16A, this uses a GPS receiver.

3. PC Based GPS
If working with ATmega gets too much for you, we have an alternative as well. This project designs a system that connects a GPS module to a PC com port, which enables you to use the navigation on a PC.

4. Low Power Inverter
Here is a simple low power inverter that converts 12V DC into 230-250V AC. It can be used to power light loads like window chargers, night lamps, or simply give a shock to keep the intruders away.

5. LPG Leakage Detector
This mini project is for a low-cost circuit for an LPG detector that you can build easily. The next time there is a leakage, you can easily be on top of things.

III Year
Detailed Syllabus

Semester - V
Syllabus

Course Title	Virtual and Augmented Reality				Course Type		Integrated	
Course Code	M20TDS511	Credits	4		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

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:

The objectives of this course are to

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:

CO#	Course Outcomes	Pos	PSOs
CO1	Summarize the fundamentals of Augmented Reality and Virtual Reality.	1,2,3,4,5	1,2,3
CO2	Apply multimodal user interaction and perception techniques involved in Virtual Reality.	1,2,3,4,5	1,2,3
CO3	Design different objects using Simulation and Interactive techniques for real world applications.	1,2,3,4,5	1,2,3
CO4	Develop innovative Virtual Reality solutions for industrial and Social relevant applications..	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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, and 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

TEXT BOOKS:

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

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.

JOURNALS/MAGAZINES:

1. Springer Journal on Virtual and Augmented Reality
2. IEEE Transaction on Virtual and Augmented Reality
3. Elsevier Journal on Virtual and Augmented Reality

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Virtual and Augmented Reality
2. https://www.classcentral.com/course/ Virtual and Augmented Reality
3. https://nptel.ac.in/courses/136/166/1116106156/

PRACTICE:

Sl. No.	List of Programs
1	Build a Virtual Reality application for the promotion of a tourist destination of your choice. This could be an application providing information about a particular destination, providing 360-degree pictures and videos of the location. The user should be able to navigate scene-by-scene through the destination that you have built the tour for.
2	Build an Augmented Reality application for making your syllabus topics interactive and fun to learn. This could be an application providing information about particular topics or subject.
3	Build a Virtual Reality application that allows prospective students, parents or elderly person to actually see a campus without having to physically be there.
4	Build a Virtual Reality application for athletics or the spectators by providing real-life images of what it's like to sit in certain seats during a game, to offering behind-the-scenes VR tours of pre-game and the athletics facilities, so it's easy to get people excited about the athletics.
5	Build an Augmented Reality application that can bring changes in the Education sector by enabling Augmented triggers around the Laboratory so when students scan through them, they can learn different safety procedures and protocols of the laboratory equipment.
6	Build an Augmented Reality application that makes the teachers to have augmented their field trips and added layers of learning and interaction to the day's activity.
7	Build an Augmented Reality application that uses face filters – a mask-like augmented reality that adds virtual objects to an individual's face during video call.
8	Build an Augmented Reality application that uses your mobile device's camera to visualize how virtual items like furnitures, home appliances, kitchen utensils would look and fits in any given space.
9	Build a Virtual Reality gaming application to play virtual Holi with colors by avoiding harmful chemicals and wastage of water
10	Build an Augmented Reality food menu application that displays virtual food

<table>
<tr><td>Course Title</td><td colspan="4">Computer Vision</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TDS512</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">V Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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:

CO#	Course Outcomes	Pos	PSOs
CO1	Utilize linear filters to enhance the quality of images.	1,2,3,4,5	1,2,3
CO2	Develop Segmentation technique to solve real world problems.	1,2,3,4,5	1,2,3
CO3	Design and Develop program for registration and classification of images.	1,2,3,4,5	1,2,3
C04	Apply object detection and recognition techniques to solve real world problems.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

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

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Edition, Pearson, 2012.

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

1. Springer Journal on Computer Vision
2. IEEE Transaction on Computer Vision
3. Elsevier Journal on Computer Vision

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Computer Vision
2. https://www.classcentral.com/course/ Computer Vision
3. https://nptel.ac.in/courses/443/766/2346106156/

PRACTICE:

Implement the list of programs using any relevant tool like Matlab, Scilab, Octave, Python,

Sl. No.	List of Programs
1	Image processing has lot of basic operations also called as preprocessing. Preprocessing involves conversion of color images to gray images. Implement conversion of colour to gray to black and white and vice versa.
2	Image classifications needs efficient feature extraction. Basic features could be edges. Implement various edge detection algorithm.
3	Histogram equalization is a method in image processing of contrast adjustment using the image's histogram. Histogram equalization often produces unrealistic effects in photographs. Write the code for obtaining histogram, and also perform histogram equalization.
4	Filtering is a technique for modifying or enhancing an image. Implement smoothing or averaging filter in spatial domain.
5	The Canny edge detector is an edge detection operator that uses a multistage algorithm to detect a wide range of edges in images. Implement the program for edge detection algorithm
6	Segmentation of certain applications need background detection, Implement the various methods for background detection.
7	Clustering has become very popular as they are used to group things having similar attributes. There are various clustering techniques used for segmentation. Implement the following: i) The Watershed Algorithm ii) Segmentation Using K-means iii) Agglomerative Clustering with a Graph iv) Divisive Clustering with a Graph
8	Image registration involves aligning of images of the same thing taken at different time. Given two images captured at different time slots, perform Image registration.
9	When images are being captured, there could be deformation, Implement the techniques used when there is deformation.
10	Classifiers are used to classify the given image. UCI machine learning repository is a hub of datasets related to computer vision. Using any dataset from Kaggle, Apply decision tree, SVM and random forest. Compare the performance.
11	Object detection and localization are used for drawing bounding boxes for objects in an image. Choose a relevant dataset from UCI machine learning repository and perform object detection
12	Random tree classifier uses multiple decision trees for better performance. Implement Random forest classifier for classification on IRIS dataset.

Course Title	Natural Language Processing				Course Type		Integrated	
Course Code	M20TDS513	Credits	4		Class		V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

The intent of the course is to give introduction to Natural Language Processing (NLP, a.k.a. computational linguistics), the study of computing systems that can process, understand, or communicate in human language. The primary focus of the course will be on understanding various NLP tasks as listed in the course syllabus, algorithms for effectively solving these problems, and methods for evaluating their performance. There will be a focus on statistical algorithms to acquire the knowledge needed to perform language processing.

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain the fundamentals of natural language processing and python
2. Discuss how to access the text corpora and Lexical Resources
3. Demonstrate the writing the structured programs to process the raw text
4. Describe role of Classifiers in Text processing.

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the fundamentals of natural language processing and python	1,2,3,4,5	1,2,3
CO2	Learn how to access the text corpora and Lexical Resources	1,2,3,4,5	1,2,3
CO3	Acquiring the skills for writing the structured programs to process the raw text	1,2,3,4,5	1,2,3
C04	Analyze the role of different classifiers in Text processing	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1			√			
CO2			√			
CO3			√			
CO4			√			

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

Language Processing and python, Accessing Text corpora and Lexical Analysis: Computing with language: Texts and words,a closer look at python: texts as list of words, computing with language: simple statistics, Automatic natural language understanding; Accessing Text Corpora, Conditional Frequency Distributions, Lexical Resources, WordNet, Introduction to NLTK Tool.

UNIT-2

Processing Raw Text: Accessing Text from the Web and from Disk, Strings: Text Processing at the Lowest Level, Text Processing with Unicode,Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text, Regular Expressions for Tokenizing Text, Segmentation, Formatting: From Lists to Strings,

UNIT-3

Categorizing and Tagging words: Using a Tagger, Using a Tagger, Mapping Words to Properties Using Python Dictionaries, Automatic Tagging, N-Gram Tagging, Transformation-Based Tagging, How to Determine the Category of a Word.

UNIT-4

Classifying Text: Supervised Classification: Examples, Evaluation; Decision Trees, Naive Bayes Classifiers, Maximum Entropy Classifiers, Modelling Linguistic Patterns.

SELF-LEARNING COMPONENT:

Extracting information from Text, Exploring the 20 Newsgroups with Text Analysis Algorithms, Stock Price prediction with Regression Algorithms, Best Practices: i) Data preparation stage ii)Training sets generation stage iii) Model training, evaluation and selection stage.

TEXT BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, First Edition, O’Reilly Media, 2009.
2. Yuxi (Hayden) Liu, “Python Machine Learning by Example”, First edition, Packt Publisher, 2017.

REFERENCES:

1. James Allen, “Natural Language Understanding”, Benjamin-Cummings Publishing Co., Inc. Redwood City, CA, USA, 1995.
2. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, The MIT Press, 1999.
3. Randolf Quirk, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik, “A Comprehensive Grammar of English Language”, Cambridge University Press, 1987.

JOURNALS/MAGAZINES:

1. Springer Journal on Natural Language Process
2. IEE Transaction on Natural Language Process
3. Elsevier Journal on Natural Language Process

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Natural Language Process
2. https://www.classcentral.com/course/ Natural Language Process
3. https://nptel.ac.in/courses/476/876/3323106156/

PRACTICE:

Sl. No.	List of Programs
1	NLTK is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum. Write a python program to extract tokens from the input sentence of English language using Python NLTK toolkit.
2	An incredible amount of unstructured text data is generated every day by social media, web pages, and a variety of other sources. But without the ability to tame and harness that data, you'll be unable to glean any value from it. In this course, learn how to translate messy text data into powerful insights using Python. Instructor Derek Jedamski begins with a quick review of foundational NLP concepts, including how to clean text data and build a model on top of vectorized text. He then jumps into more complex topics such as word2vec, doc2vec, and recurrent neural networks. Develop a python program to create social network structure of LinkedIn profile using python NLTK toolkit.
3	Analysing movie reviews data and try to predict whether the review is positive or negative. Familiarity with some machine learning concepts will help to understand the code and algorithms used. Develop a program to analyze the review comments of a movie trailer to provide rating using Python NLTK Toolkit
4	Cluster is a process of grouping similar items together. Ecah group, also called as a cluster, contains items that are similar to each other. Clustering algorithms are unsupervised learning algorithms Develop a program to cluster similar text documents using Python NLP Toolkit.
5	A popular NLP application called Machine Translation. In Machine Translation, you take in a bunch of words from a language and convert these words into another language. Develop a NLP program to convert simple sentences from one language to another.
6	Sentiment Analysis is the process of 'computationally' determining whether a piece of writing is positive, negative or neutral. It's also known as **opinion mining**, deriving the opinion or attitude of a speaker. Analyse twitter sentimental data set to predict the sentiments.
7	While the voice of an individual is unique, secure authentication through voice recognition can be a challenge in some cases – for instance, if the user has a sore throat or cold. It is therefore important to prevent unauthorized users from hacking into the database by mimicking someone else's voice. Develop program to recognize speech for authentication.
8	Text summarization is the process of creating a short, accurate, and fluent summary of a longer text document. It is the process of distilling the most important information from a source text. Automatic text summarization is a common problem in machine learning and natural language processing (NLP). Automatic text summarization methods are greatly needed to address the ever-growing amount of text data available online to both better help discover relevant information and to consume relevant information faster. Perform document summarization using NLP toolkit.
9	An IVR system's effectiveness is rated by the percentage of callers who ask to speak to a live operator. The lower the percentage, the more successful the system. Of course there are some IVR systems that never give you the option of speaking to a live operator.

	Develop an IVR system for REVA University.
10	Again, for services and email clients not mentioned here, you can almost always prevent emails from getting sent to spam simply by adding the sender to your address book or contacts. If it has an option to mark as “Not Spam”, “Remove From Spam”, or something similar, you can always click that too. However, it’s generally better to add a sender. Develop a program to classify mails to spam.

Course Title	Open Elective				Course Type	Theory	
Course Code	M20TDO502	Credits	4		Class	V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	4	4	4			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**4**	**4**	**52**	**50**	**50**

An **Open Elective** is a powerful tool introduced in engineering syllabus which allows allows university students to study the syllabus by picking subjects, usually from another stream. Apart from that, it's a chance for students to gain skills they feel they are lacking or need to improve.

Course Title	Capstone Project Work Phase – I				Course Type	Practice	
Course Code	M20TD0503	Credits	4		Class	V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	4	4	4	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**4**	**4**	**52**	**50**	**50**

COURSE OVERVIEW

The major project is a two semester-long practical project with the main objective that students show their ability to apply theoretical concepts learned in lectures to solve (complex) practical problems. The results are to be presented in a project report and as an oral presentation.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3

CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3	3	3
CO2		3										3	3	3

CO3			3									3	3	3
CO4				3								3	3	3
CO5					3							3	3	3
C06						3						3	3	3
CO7							3					3	3	3
CO8								3				3	3	3
CO9									3			3	3	3
CO10										3		3	3	3
CO11											3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Capstone-Project Phase-1:

- Student should carry out project work in V semester. Student must select a faculty member from department of CSE as an internal project guide based on research domain and expertise. Student may optionally also select external guide bearing domain expertise from different departments within University and Industry to carry out multidisciplinary project.
- Student must propose a project title, after consultation with guides and after carrying out a literature survey. The proposed title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction, Survey, Feasibility, and cost estimation to carry out the project.
- Further with the help of respective guide, each student have to the literature review based on the literature survey, identify the research gaps in the selected research/project domain, and then finalize the problem statement and objectives for the project.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the synopsis and justification of the title and feasibility of the project
- Review 2 shall be on the presentation on the literature survey carried out.

Finally, the Capstone-Project Phase-1 shall conclude with each project apply for idea patent or copyright and publish a survey paper in SCOPUS indexed journals, write research proposals for fundings from various governmental organizations or industries

Course Title	Global Certification				Course Type	Practice	
Course Code	M20TD0504	Credits	4		Class	V Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	0	0	o			
	Practice	4	0	0	Practice	CIE	SEE
	-	0	-	-			
	Total	4	4	4	52	50	50

COURSE OVERVIEW

The Global Certification is a one semester intensive project based learning approach to cater with the Industry requirement. It prepares the students to up skill their knowledge base to compete in terms of latest technology and become competent enough to the industry requirment. In this, students will be able to solve complex real world problems pertaining to the domain chosen and gain confidence. It is an individual course and students have to earn the certificate based on their performances in terms of project assignment and aptitude. Student have to choose two Global certification courses.

COURSE OBJECTIVE (S):

1. To allow students to learn skills of their choice required in the current Industry perspective.
2. To encourage building multidisciplinary skill set through the integration of courses learned.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To prepare them to face the interview as professionals by improving communication skills.

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3

CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3	3	3
CO2		3										3	3	3
CO3			3									3	3	3
CO4				3								3	3	3
CO5					3							3	3	3
C06						3						3	3	3
CO7							3					3	3	3
CO8								3				3	3	3
CO9									3			3	3	3
CO10										3		3	3	3
CO11											3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Global Certification

- Student should choose two Global certifications among the available Industry ready courses to cope up with the vast changing software world.
- Student should register for the course having minimum of 39 hours of teaching and should have 100 percent attendance for all the sessions.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the course, assignment completed followed by viva.
- Review 2 shall be on the presentation of their overall skills learned in the course followed by their certificate verification.

Semester - VI
Syllabus

Course Title	Capstone Project Work and Dissertation				Course Type	Practice	
Course Code	M20TD0601	Credits	12		Class	VI Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes per Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	12	12	12	Practice	CIE	SEE
	-	0	-	-			
	Total	12	12	12	208	50	50

COURSE OVERVIEW

Project Phase-2 is continuation of Project Phase-1 from semester V.

COURSE OBJECTIVE (S):

1. To allow students to demonstrate a wide range of the skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation.
2. To encourage multidisciplinary research through the integration learned in a number of courses.
3. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
4. To encourage teamwork.
5. To improve students' communication skills by asking them to produce both a professional report and to give an oral presentation

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3

CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3						√
CO4				√		
CO5			√			
C06			√			
CO7		√				
CO8		√				
CO9	√			√		
CO10			√			√
CO11		√		√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											3	3	3
CO2		3										3	3	3

CO3			3									3	3	3
CO4				3								3	3	3
CO5					3							3	3	3
C06						3						3	3	3
CO7							3					3	3	3
CO8								3				3	3	3
CO9									3			3	3	3
CO10										3		3	3	3
CO11											3	3	3	3

Note: 1-Low, 2-Medium, 3-High

The students are informed to follow the following instructions to complete the Project Phase-2:

- Each student shall conduct the required experiment to implement the proposed project with the consultation of respective guides.
- Each student shall be reviewed and evaluated in two reviews through the semester and finally each student shall demonstrate the completed project to a team of examiners.
- Review 1 shall be on the presentation of the methodology employed and model created.
- Review 2 shall be on the presentation on the functional project.
- Finally, the Project Phase-2 shall conclude with each project apply for patent or copyright and publish a paper in SCOPUS indexed journals.
- In Semester end examination, each student shall be evaluated, based on the course outcomes.

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 &