10 YEARS OF UNIVERSITY RECOGNITION

20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY

Bengaluru, India

HANDBOOK OF

M. Tech. in Computer Science & Engineering

(FULL TIME)

ACADEMIC YEAR 2023-25

www.reva.edu.in

RUKMINI EDUCATIONAL

Charitable Trust

REVA UNIVERSITY
Bengaluru, India

School of Computer Science and Engineering

HANDBOOK

M. Tech. in Computer Science and Engineering

[Full Time]

2023-25

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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. ShyamaRaju

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

Pro Vice-Chancellor's Message

Education is one of the most effective weapons now accessible to effect change in the world. Despite the fact that education levels vary from country to country, there is a direct correlation between a country's educational system's quality and its general economic health. In general, developing nations tend to offer their citizens higher-quality education than do least developed nations, with fully developed nations offering the best education of all. Education clearly has a significant role in a country's overall well-being. The Global Partnership for Education asserts that education is viewed as an essential element of social, economic, and personal development and is therefore a fundamental human right. Education encourages gender equality, peace, and the possibility of having better opportunities.

Since its inception, REVA University is committed providing quality education. All the programs are created to meet worldwide standards as university primary goal is to offer higher education of global standard. The university has highly qualified and experienced faculty members who created enhanced student-centric learning environment. Curriculum flexibility is incorporated to provide skill based knowledge gaining along with foundation study to meet job market requirements in industry. Innovation in teaching learning is brought in terms of various project courses introduced in most of the semesters and students are supported for startups through REVA NEST – incubation center. Students are encouraged to participate in premiere technical competitions and competitive exams along with cultural and sports fests.

REVA University collaborated with a number of premiere industries and universities in India and abroad. Several outreach and societal activities are initiated by the university wherein students and faculty are involved in Jagruthi, REVA Vanamahotsava, Abhivruddi, and Education on Wheels. Clubs and Forums provide a platform to students to exhibit their talents in technical, cultural, and sports activities.

REVA is a one-stop solution to students to build their overall personality during their degree program and emerge as leaders in their chosen fields.

School of CSE is most sought after program in REVA University. Wish you all the best.

Dr. R. C. Biradar
Pro Vice-Chancellor

Director's Message

Congratulations and welcome all new students to the prestigious Department of Computer Science and Engineering. The Department has a rich blend of experienced and energetic faculty who are well-qualified in various aspects of Electronics, and Computer Science. The Department possesses numerous state-of-the-art digital classrooms and laboratories having contemporary computing equipment, including cloud-based systems. The Department offers B.Tech. In Computer Science and Engineering, B.Tech in Artificial Intelligence and Data Science, M.Tech in Computer Science and Engineering (Full Time) and M.Tech in Computer Science and Engineering (Part-Time). In addition, the Department has a research center in which a student can conduct cutting-edge research leading to a Ph.D. degree. The faculties pursue research in areas like Data Mining. Healthcare Systems, Blockchain, Wireless Networks and Computing, Cloud Computing, Image Processing, Software Architecture, and Machine Learning Applications.

Curricula of both undergraduate and postgraduate programmes have been designed through a collaboration of alumni, academic, research, and industry experts to bridge the gap between industry and academia and inculcate innovation and leadership qualities. This makes the programme highly practical and industry-oriented. The B.Tech programme aims to create quality human resources to play leading roles in the contemporary, competitive industrial and corporate world. The Master's Degree focus on quality research and design in the core and application areas to foster a sustainable world and 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' programmes. Research degree programmes aim to design and develop solutions to contemporary computer and engineering technologies oriented towards human development.

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

Welcome to the Department of Computer Science and Engineering at REVA University for better learning and becoming future leaders for the nation's socio-economic growth and the world.

Dr. Ashwinkumar U Motagi
Director, School of CSE

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RUKMINI EDUCATIONAL CHARITABLE TRUST

It was the dream of late Smt. RukminiShyamaRaju to impart education to millions of underprivileged children as she knew the importance of education in the contemporary society. The dream of Smt. Rukmini ShyamaRaju 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. ShyamaRaju, 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. ShyamaRaju 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 PradhanMantriKaushalVikasYojana. 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 AND 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 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

Department of Computer Science and Engineering aspires to create a pool of high-calibre technologists and researchers in the field of computer science and engineering who have potential to contribute for development of the nation and society with their expertise, skills, innovative problem-solving abilities and strong ethical values.

.Mission

MD1: To create center of excellence where new ideas flourish and from which emerge tomorrow's researchers, scholars, leaders, and innovators.

MD2: Provide quality education in both theoretical and applied foundations of computer science and engineering, related inter-disciplinary areas and train students to effectively apply the knowledge to solve real-world problems.

MD3: Amplify student's potential for life-long high-quality careers and make them competitive in ever-changing and challenging global work environment.

MD4: Forge research and academic collaboration with industries and top global universities in order to provide students with greater opportunities.

MD5: Support the society by encouraging and participating in technology transfer.

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 & Organization	Role
1.	Dr. Ashwin Kumar U M	Deputy Director and Professor School of CSE, REVA University, Bengaluru	Chair Person
2.	Dr. Shashidhar Babu S	Professor, School of CSE, REVA University, Bengaluru	Member
3.	Dr K Amuthabala	Associate Professor, School of CSE, REVA University, Bengaluru	Member
4.	Dr.Prabhakar M	Associate Professor, School of CSE, REVA University, Bengaluru	Member
5.	Dr.Laxmi R	Associate Professor, School of CSE, REVA University, Bengaluru	Member
6.	Dr.Vani K	Associate Professor, School of CSE, REVA University, Bengaluru	Member
7.	Dr. Akram Pasha	Associate Professor, School of CSE, REVA University, Bengaluru	Member
8.	Dr. T G Basavaraju	Professor and HEAD, Dept. of CSE, Govt. Engg. College, Hassan	Member
9	Dr. Nagaraju G C	Professor Dept.of CSE, R V College of Engineering, Bengaluru	Member

10.	Dr.Sheela Kathavate	Associate Professor, Dept. of ISE, BMSIT, Bengaluru	Member
11.	Dr. Vinoda K	Associate Professor, School of CSE, PES University, Bengaluru	Member
12.	Mr. Nitin Narayan Shelar	Chief Architect, Radisys India Pvt.Ltd	Member
13.	Mr Kiran Desai	Alumni, 2022-M.Tech (CSE) , Scientist/Engineer-SF, Functional designation: Section head-Simulation Validation section, U R Rao Satellite Centre, ISRO, Old Airport, Vimanapura, Bangalore. kirandes@ursc.gov.in	Member
14.	Mr Ganesh Prasad	CEO, ARKVERSE Private Limited, Bangalore. gprao@arkverse.in 9591523413	Member
15.	Mr. Amaanullah R21TC001	Student	Member
16.	Mr.Shijin K P R21TD014	Student	Member

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 Computer Science was taught as part of mathematics or engineering departments and in the last hardware. ComputerScience and engineeringhas roots in electrical engineering, mathematics, and linguistics. In the past 3 decades it has emerged as a separate engineering field. In the present information era (Knowledge era) computer science and engineering will see an exponential growth as the future machines work on artificial intelligence.

The oldest known complex computing device, called the Antikythera mechanism, dates back to 87 B.C., to calculate astronomical positions and help Greeks navigate through the seas. Computing took another leap in 1843, when English mathematician Ada Lovelace wrote the first computer algorithm, in collaboration with Charles Babbage, who devised a theory of the first programmable computer. But the modern computing- machine era began with Alan Turing's conception of the Turing Machine, and three Bell Labs scientists invention of the transistor, which made modern-style computing possible, and landed them the 1956 Nobel 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 bringing progress to all level society.

The career opportunities for computer science and engineering graduates are plenty and growing. Programming and software development, information systems operation and management, telecommunications and networking, computer science research, web and Internet, graphics and multimedia, training and support and compute rindustry 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 MTech., 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 problemsolving abilities for a smooth transition from academic to real-life work environment. In addition, students are trained in interdisciplinary topics and attitudinal skills to enhance their scope. The above-mentioned features of the programme, advanced teaching and learning resources, and experience of the faculty members with their strong connections with ICT sector makes this programme unique.

Program Educational Objectives (PEO's)

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

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

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

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

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

Program Outcomes (POs)

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, and model, analyze and evaluate the solution and report as a dissertation in the area of Computer Science and Engineering.

REVA UNIVERSITY
Bengaluru, India

ACADEMIC REGULATIONS

M. Tech., (2 years/3 Years) Degree Programs
(Applicable for the programs offered from 2022-23 Batch)

Regulations – M Tech., Degree Program
Academic Year 2022-23 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 2022-23 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
Cybersecurity
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:

3.1 **Duration:** The duration of theM Tech degree program shall be **TWO years** comprising of **FOUR** Semesters. A candidate can avail a maximum of 8 semesters - 4 years as per double duration norm, in one stretch to complete M Tech degree. The duration for part time students is **THREE years** and a maximum of 6 years they are required to complete the program.

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, T and P.

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 (CC):** A course which should compulsorily be studied by a candidate choosing a particular program of study

4.2.2 **Foundation Course (FC):** 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	4 Semesters	B E / B.Tech. in CSE / ISE / TE / MCA / M. Sc. In

	Technology (M Tech) in Artificial Intelligence	(2 years)	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. For admission to Part-Time: In addition to the qualification prescribed above (a), the candidate must have worked for not less than three years (after qualifying examination, experience is considered up to the date of notification of REVA University inviting applications for admission)
3	M Tech in Computer Aided Structural Engineering Construction Technology & Management Transportation Engineering and Management	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.
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	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	Full Time – 4 Semesters	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical

	and Embedded Systems	(2 years) Part Time – 6 Semesters (3 years)	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 /Mechatronics,Industrial Engineering, Production Engineering,Production Engineering and Systems Technology. Automobile / Industrial Production Engineering with a minimum of 50% (45% in case of candidatebelonging to SC/ST category) marks in aggregate, of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
8	M Tech in Cybersecurity	Full Time – 4 Semesters (2 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.

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 = 14 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.

The following table describes credit pattern

Table-2: CreditPattern					
Lectures(L)	**Tutorials(T)**	**Practice (P)**	**Credits(L:T:P)**	**Total Credits**	**TotalContac 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 such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to IV semester and complete successfully 72 credits in 4 successive semesters shall be considered for declaration of Ranks, Medals, Prizes and are eligible to apply for Student Fellowship, Scholarship, Free ships, and such other rewards / advantages which could be applicable for all full time students and for hostel facilities.

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:

Assignments ……10 marks for first 50% of the syllabus (scaled down to 5 marks)
Seminars …….. 10 marks for first 50% of the syllabus (scaled down to 5 marks)
Test-1 ……30 marks for the first 50% of the syllabus (scaled down to 15 marks)
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:

Assignments ……10 marks for second 50% of the syllabus (scaled down to 5 marks)
Seminars …….. 10 marks for second 50% of the syllabus (scaled down to 5 marks)
Test-1 ……30 marks for the second 50% of the syllabus (scaled down to 15 marks)
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	First 50%		Instructional process and

	Week			Continuous Assessment
	Last 3 days of 8th Week		25%	Consolidation of IA1
IA2	9th week to 16th week	Second 50%		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
***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 will be announced.**				

9.3 Evaluation of practicals (Lab components)

There can be two types of lab components: ***Integrated lab and Separate lab***

9.3.1 Evaluation of Separate lab

The 50 marks meant for internal assessment (IA) evaluation in case of separate lab course shall 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**

The 50 marks meant for Semester End Examination (SEE) in case of separate lab course shall be allocated as under:

i	Conduction of practical (experiment)	30 marks

ii	Write up about the experiment/tabulation/results/inference	10 marks
iii	Viva-Voce	10 marks
	Total	**50marks**

9.3.2 Assessment of integrated lab course*

The 10 marks meant for Internal Assessment (IA) of the performance in carrying out Integrated lab course shall further be allocated as under:

i	Conduction of regular practical / experiments throughout the semester	10 marks
ii	Maintenance of lab records and performance of internal lab test to be conducted after completion of all the experiments before last working day of the semester	10 marks
	Total	**20 marks**

*Note: For integrated lab course, no separate assignment or seminar marks will be allocated.

9.4 The Assessment of MOOC and Online Courses

MOOC and Online courses shall be decided by the concerned School Board of Studies (BOS).

9.4.1 For >= 2 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**

9.4.2 For 1 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**

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%.

Note: Candidate is eligible to submit project dissertation only after clearing all theory courses of the program.

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 50% (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+
< 50	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 (Cred 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	22	8.36	22 x 8.36 = 183.92
2	22	8.54	22 x 8.54 =187.88
3	16	9.35	16x9.35=149.6
4	12	9.50	12x9.50=114
Cumulative	**72**		635.4

$$CGPA = \frac{22\ X8.36 + 22\ X\ 8.54 + 16X9.35 + 12X9.5}{72} = 8.33$$

13.3 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 8.83 x 10=88.30

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	Pass
CGPA <5	5	F	Fail	Fail

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 anyother 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 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 50% 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 50% (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. Challenge Valuation:

a. A student who desires to apply for challenge valuation shall obtain a photo copy of the answer script(s) of semester end examination by paying the prescribed fee within 10 days after the announcement of the results. He / She can challenge the grade awarded to him/her by surrendering the grade card and by submitting an application along with the prescribed fee to the Controller of Examinations within 10 days after the announcement of the results. This challenge valuation is only for semester end examination.

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

24. 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
[Full Time]
Scheme of Instructions
(Effective from the Academic Year 2022-23)
I SEMESTER

Sl. No	Course Code	Title of the Course	HC/ FC /SC/ OE/ MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	M22TC0101	Optimization Techniques	HC	3	0	0	3	3	50	50	100	PCC
2	M22TC0102	Advanced Database Management Systems	HC	3	0	0	3	3	50	50	100	PCC
3	M22TC0103	Advanced Machine Learning	HC	3	0	0	3	3	50	50	100	PCC
4	M22TC0104	Advanced Java Programming	HC	3	0	0	3	3	50	50	100	PCC
5	M22TC0105	Advanced Algorithms	HC	3	0	0	3	3	50	50	100	PCC

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE/MC	Credit Pattern					Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P		Total Credit		CIE Marks	SEE Marks	Total Marks	
6	M22TC0106	IoT Design and Cyber Physical Systems	HC	3	0	0		3	3	50	50	100	PCC
7	M22TC0107	Research Methodology and IPR	HC	3	0	0		3	3	50	50	100	PCC
8	M22TCS211	Cloud Computing Tools	HC	0	0	1		1	2	25	25	50	PCC
1	M22TCS212	Advanced Machine Learning lab	SC	3	0	0		3	3	50	50	100	PEC
9	M22TC0109	Mini Project	HC	0	0	2		2	4	25	25	50	PCC
	M22TCS221	Big data Analytics											
	M22TCS222	Wireless and Mobile Networks											
2	M22TCS223	Design Principles of User Interface / User Experience	SC	3	0	0		3	3	50	50	100	PEC
		Advanced Unix System Programming											
3	M22TCS231		SC	3	0	0		3	3	50	50	100	PEC
		TOTAL		21	0	3		24	27	400	400	800	
		TOTAL SEMESTER CREDITS								24			
		TOTAL CUMULATIVE CREDITS								24			
		TOTAL CONTACT HOURS								27			
		TOTAL MARKS								800			

II SEMESTER

	M22TCS232	Mobile Application Development										
	M22TCS233	Image Processing and Analysis										
4	M22TCS241	Data Storage Technology and Network	SC	3	0	0	3	3	50	50	100	PEC
	M22TCS242	Program Analysis										
	M22TCS243	Data Preparation and Analysis										
5	M22TCS251	Robotic Process Automation	SC	3	0	0	3	3	50	50	100	PEC
	M22TCS252	Agile Software Development										
	M22TCS253	Deep Learning										
6	M22TC0206	Cyber Security Lab	HC	0	0	1	1	2	25	25	50	PCC
7	M22TC0207	Big data Analytics lab	HC	0	0	1	1	2	25	25	50	PCC
8	M22TC0208	Mobile Application Development lab	HC	0	0	1	1	2	25	25	50	PCC
9	M22TC0209	Mini Project	HC	0	0	2	2	4	25	25	50	PCC
10	M22AS0201	Tree Plantation in Tropical Region: Benefits and Strategic Planning	FC	1	0	0	1	1	25	25	50	HSCM
TOTAL				**16**	**0**	**5**	**21**	**26**	**375**	**375**	**750**	
TOTAL SEMESTER CREDITS				**21**								
TOTAL CUMULATIVE CREDITS				**45**								
TOTAL CONTACT HOURS				**26**								
TOTAL MARKS				**750**								

III SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE/MC/ SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	M22TCS311	Multicore Architecture and Programming	SC	3	0	0	3	3	50	50	100	PEC
	M22TCS312	Computer Vision										
	M22TCS313	Advance Information Security										
2	M22TC0302	Project Work Phase-1	HC	0	0	4	4	8	50	50	100	PCC

3	M22TC0303	Internship/Global Certification	HC	0	0	4	4	8	50	50	100	PCC
4	M22TCO301	Open Elective	OE	4	0	0	4	4	50	50	100	PCC
Total				**07**	**0**	**8**	**15**	**23**	**200**	**200**	**400**	
TOTAL SEMESTER CREDITS				**15**								
TOTAL CUMULATIVE CREDITS				**60**								
TOTAL CONTACT HOURS				**23**								
TOTAL MARKS				**400**								

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC /SC/OE /MC/SDC	Credit Pattern				Contact Hours/ Week	Examination			Course category (As per AICTE)
				L	T	P	Total Credit		CIE Marks	SEE Marks	Total Marks	
1	M22TC0401	Project-Work Phase-2 and Dissertation	HC	0	0	12	12	24	50	50	100	PCC
Total				**0**	**0**	**12**	**12**	**24**	**50**	**50**	**100**	
TOTAL SEMESTER CREDITS				**12**								
TOTAL CUMULATIVE CREDITS				**72**								
TOTAL CONTACT HOURS				**24**								
TOTAL MARKS				**100**								

Total Credits: 72

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

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

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

Project work phase – 2, in 4thsemester should have an outcome: publication in a reputed National/International Journal or a patent filing to earn 2 credits.

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

The registration must happen before beginning of the third semester.

NPTEL: Student should enroll for Nptel course from non computer science and engineering/multidisciplinary stream.

I Year

Detailed Syllabus

I Semester
Syllabus

Course Title	Optimization Techniques			Course Type	Theory
Course Code	M22TC0101	Credits	3	Class	I Semester

	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
Course Structure	Theory	3	3	3	Theory	CIE	SEE
	Practice	0	0	0			
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

The course intends to present a thorough concept of optimization and distinct types of optimization algorithms, and their properties to solve problems. One finds optimization playing a critical role even in contemporary areas such as decision and control, signal processing, and machine learning. Emphasis is on methodology and the underlying mathematical structures. This course is an important part of the postgraduate stage in education for formulating every engineering design problem. It is also useful for students who would like to gain knowledge and skills in an important part of math. It gives students skills for implementation of the mathematical knowledge and understanding the role of optimization in engineering design.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explains the distinct optimization techniques based upon the fundamentals of engineering mathematics.

2. Describes problem formulation by using linear programming and unconstrained optimization techniques for various methods.

3. Discusses constrained optimization techniques, direct and indirect methods of solving various problems

4. Illustrate modern methods of optimization and Neural-Network-based optimization.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Comprehend the need and applications of the optimization methods.	1 to 5	1,2
CO2	Make use of linear programming to formulate the problem to solve using optimization methods.	1 to 5	1,2
CO3	Utilize unconstrained optimization techniques to solve real world problems.	1 to 5	1,2,3

CO4	Compare and Contrast unconstraint and constrained optimization techniques and apply integer programming to get optimal solution to a	1 to 5	1,2,3
CO5	Apply Modern genetic algorithms to solve various problems	1 to 5	1,2,3
CO6	Develop algorithms using Neural-Network-based optimization and Linear programming models	1 to 5	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			√	√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	3	1							2	2	
CO2	2	2	2	3	2							3	3	
CO3	2	2	2	2	2							3	3	2
CO4	2	2	2	3	2							3	3	2
CO5	3	3	3	3	3							3	3	3
CO6	3	3	3	3	2							3	3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

Optimization: Introduction, engineering applications of optimization, Statement of an optimization problem, Classification of optimization problems. Classical Optimization Techniques- Single variable optimization, Multivariable optimization with no constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality constraints.

UNIT – 2

Linear Programming: Introduction, Applications of Linear Programming, Standard Form of a Linear Programming Problem, Simplex Algorithm, Two Phase of the Simplex Method. Nonlinear Programming: Introduction, Unimodal Function, Elimination Methods- Unrestricted search, Exhaustive Search.

Nonlinear Programming: Unconstrained Optimization Techniques: Introduction, Direct Search Methods, Random Search Methods, Indirect search(Descent) methods, Gradient of a function, Steepest Descent(Cauchy) Method, Newton's Method.

UNIT – 3

Nonlinear Programming: Constrained Optimization Techniques: Introduction, Characteristics of a Constrained Problem, Direct Methods- Random Search Method, Complex Method, Sequential Linear Programming, Basic approach in the methods of feasible directions. Indirect Methods- Transformation Techniques, Basic Approach of the Penalty Function Method, Interior Penalty Function Method, Convex Programming Problem, Exterior Penalty Function Method.

Integer Programming- Introduction, Integer linear programming- Graphical representation, Gomory's Cutting Plane Method. Integer nonlinear Programming- Branch-and-Bound Method.

UNIT – 4

Modern Methods of Optimization- Introduction, Genetic Algorithms- Introduction, Representation of Design Variables, representation of Objective function and constraints, Working Principles, Difference between GAs and Traditional Methods, Similarities between GAs and Traditional Methods, Optimization of Fuzzy Systems, Neural-Network-Based Optimization

TEXT BOOKS:

1. Singiresu S. Rao," Engineering Optimization – Theory and Practices", John Wiley & Sons, 4th Edition, 2009.
2. Kalyanmoy Deb, Optimization for Engineering design – algorithms and examples. PHI, New Delhi, 1995
3. Garfinkel, R.S. and Nemhauser, G.L., Integer programming, John Wiley & Sons, 1972.
4. Arora J. – 'Introduction to Optimization Design' – Elsevier Academic Press, New Delhi – 2004

REFERENCE BOOKS:

1. Ronald L. Rardin, “Optimization in Operations Research”, Second edition, Pearson India,
2. ISBN-13: 978-0-13-438455-9, 1999
3. D.G. Luenberger and Y. Ye, “Linear and Nonlinear Programming”, Springer, 2008
4. Jorge Nocedal, Stephen J. Wright, “Numerical Optimization”, Springer Series in Operations Research and Financial Engineering, Springer, 1999.
5. J. K. Sharma, “Operations Research”, Macmillan, 5 th Edition, 2012.
6. R. Pannerselvan, “Operations Research”, 2 nd Edition, PHI Publications, 2006.
7. S. Sra, S. Nowozin, and S. Wright (eds). Optimization for Machine Learning, The MIT Press, 2011.

JOURNALS/MAGAZINES

1. https://www.springer.com/journal/10957
2. https://www.hindawi.com/journals/jopti/
3. https://www.tandfonline.com/journals/gopt20
4. https://ieeexplore.ieee.org/document/655049

SWAYAM/NPTEL/MOOCs:

5. https://nptel.ac.in/courses/111105039
6. https://onlinecourses.nptel.ac.in/noc21_me10/preview
7. https://www.coursera.org/learn/optimization-for-decision-making
8. https://www.udemy.com/course/optimisation/

SELF-LEARNING EXERCISES:

Implementation of Newton's method, Lagrange multiplier method, KKT theorem in MATLAB

Course Title	Advanced Database Management Systems				Course Type	Theory	
Course Code	M22TC0102	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**	**42**	**50**	**50**

COURSE OVERVIEW

Database systems have made our lives easier by providing companies to store information that can be accessed by people who require it. Hence, database courses are in huge demand currently. The course is designed to provide the learner a strong background in the area of Database Management Systems which we use in diverse domains of computing. After completing this course student will be able to do the parallel and distributed databases, database security, multimedia and spatial databases, mobile and cloud databases.

COURSE OBJECTIVE (S)

The objectives of this course are to:

1. Identify advance database concepts and database models and define the concepts of parallel and distributed databases.
2. Describe database security and different types of security models.
3. Apply multimedia and spatial databases and its applications.
4. Develop advanced data models to handle threat issues and counter measures.
5. Demonstrate the mobile data processing and management.
6. Discuss database options and role of the DBA in cloud databases.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Identify advance database concepts and database models and define the concepts of parallel and distributed databases.	1 to 5	2,3
CO2	Describe database security and different types of security models.	1 to 5	2,3
CO3	Apply multimedia and spatial databases and its applications.	1 to 5	2, 3
CO4	Develop advanced data models to handle threat issues and counter measures.	1 to 5	2,3
CO5	Examine the issues related to multimedia and mobile database performance.	1 to 5	2,3
CO6	Discuss database options and role of the DBA in cloud databases.	1 to 5	2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√	√		
CO6			√	√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2									3	3
CO2	3	3	2	2	3									3	3

CO3	3	3	1	3	3									3	3
CO4	3	3	3	2	3									3	3
CO5	3	2	2	1	3									3	3
CO6	3	2	2	2	3									3	3

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

COURSE CONTENTS:

UNIT 1

Parallel And Distributed Databases: Database System Architectures, Centralized and Client-Server Architectures – Server System Architectures Parallel Databases: I/O Parallelism –Query and operations, Parallelism –Distributed Databases Three Tier Client Server Architecture

UNIT- 2

Database Security: Introduction to Database Security, Issues –Security Models – Different Threats to databases – Counter measures to deal with these problems

UNIT -3

Multimedia and Spatial Databases: Multimedia sources, issues, Multimedia database applications, Spatial databases -Types of spatial data– Indexing in spatial databases.

UNIT- 4

Mobile and Cloud Databases: Location and handoff management, Data processing and mobility, Transaction management in mobile database systems, Database options in the cloud, Changing role of the DBA in the cloud

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.
3. Fundamental of Database Systems, Elmasri & Navathe, Pearson Education, 2010

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGrawHill, 2010.
2. C J Date, Database Design and Relational Theory: Normal Forms and All that Jazz, O 'Reilly, April 2012.
3. IEEE, IEEE Transactions on Knowledge and Data Engineering
4. Elsevier, Elsevier Data and Knowledge Engineering
5. ACM, ACM Transactions on Database Systems

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106105175
2. https://onlinecourses.nptel.ac.in/noc22_cs51/preview
3. https://onlinecourses.nptel.ac.in/noc21_cs87/preview
4. https://onlinecourses.nptel.ac.in/noc20_cs48/preview
5. https://www.coursera.org/lecture/data-manipulation/parallel-and-distributed-query-processing-1HlDA

Course Title	Advanced Machine Learning				Course Type	Theory	
Course Code	M22TC0103	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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

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 to 5	1,2,3
C02	Analyze the various Learning trees used in real world problems.	1 to 5	1,2,3
C03	Design simple linear models to solve real world problems.	1 to 5	1,2,3
C04	Formulate different dimensionality reduction techniques to real world problems.	1 to 5	1,2,3
CO5	Apply the concepts in Bayesian analysis from probability models and methods	1 to 5	1,2,3
CO6	Understand the mathematics necessary for constructing novel machine learning solutions.	1 to 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			√			
CO5			√			
CO6			√			√

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**	**3**
CO2	2	3	3	2	3							**3**	**3**	**3**
CO3	3	2	2	2	3							**3**	**3**	**3**
CO4	3	3	2	2	3							**3**	**3**	**3**
CO5	3	2	2	3	3							**3**	**3**	**3**

CO6	3	3	2	2	3							**3**	**3**	**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 : 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 2Practice, 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 Springer Journal of Machine Learning

2 Elsevier Journal of Machine Learning with Applications

3 IEEE Transactions on Pattern Analysis and Machine Intelligence

SWAYAM/NPTEL/MOOCS:

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

Course Title	Advanced Java Programming				Course Type	Theory	
Course Code	M22TC0104	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**	**42**	**50**	**50**

COURSE OVERVIEW:

This course focuses on advanced concepts in the java programming that includes web application based on Java uses Servlet, JSP, JSF. To store the data database connectivity and database JDBC component is needed. Networking components are needed to transfer data over network. Model-View-Controller (MVC) architecture gives flexibility and makes the web applications loosely coupled.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of programming the network using Java.
2. Illustrate the design of database Programming using JDBC.
3. Impart the concepts of Servlet API using Java.
4. Discuss the implementation of an application using Java Server Pages

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Implement Networking and Data base connectivity in Java for given application.	1 to 5, 9 to 11	1,2,3
CO2	Implement webpage with dynamic content and server side web application using Servlet and JSP.	1 to 5, 9 to 11	1,2,3
CO3	Use web application framework JSF to build user interfaces.	1 to 5, 9 to 11	1,2,3
CO4	Use Object Relation Mapping using Hibernate to build database dependent applications	1 to 5, 9 to 11	1,2,3
CO5	Apply Model-View-Controller architecture to build complex client-server applications.	1 to 5, 9 to 11	1,2,3
CO6	Apply concepts of advanced java in developing real time projects	1 to 5, 9 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			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	1	3				1	2	3	3	3	3
CO2	3	2	3	1	3				1	2	3	3	3	3
CO3	3	2	3	1	3				1	2	3	3	3	3

CO4	3	2	3	1	3				1	2	3	3	3	3
CO5	3	2	3	1	3				1	2	3	3	3	3
CO6	3	2	3	1	3				1	2	3	3	3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

Java Networking: Network Basics and Socket overview, TCP/IP client sockets, URL, TCP/IP server sockets, Datagrams, java.net package Socket, ServerSocket, InetAddress, URL, URLConnection

UNIT – 2

JDBC Programming: The JDBC Connectivity Model, Database Programming: Connecting to the Database, Creating a SQL Query, Getting the Results, Updating Database Data, Error Checking and the SQLException Class, The SQLWarning Class, The Statement Interface, PreparedStatement, CallableStatement The ResultSet Interface, Updatable Result Sets, JDBC Types, Executing SQL Queries, ResultSetMetaData, Executing SQL Updates, Transaction Management.

UNIT – 3

Servlet API and Overview Servlet Model: Overview of Servlet, Servlet Life Cycle, HTTP Methods Structure and Deployment descriptor ServletContext and ServletConfig interface, Attributes in Servelt, Request Dispacher interface, The Filter API: Filter, FilterChain, Filter Config, Cookies and Session Management: Understanding state and session, Understanding Session Timeout and Session Tracking, URL Rewriting

UNIT – 4

Java Server Pages JSP Overview: The Problem with Servlets, Life Cycle of JSP Page, JSP Processing, JSP Application Design with MVC, Setting Up the JSP Environment, JSP Directives, JSP Action, JSP Implicit Objects

JSP Form Processing, JSP Session and Cookies Handling, JSP Session Tracking JSP Database Access, JSP Standard Tag Libraries, JSP Custom Tag, JSP Expression Language, JSP Exception Handling, JSP XML Processing

TEXT BOOKS:

1. Black Book " Java server programming" J2EE, 1st ed., Dream Tech Publishers, 2008. 3. Kathy walrath "
2. Complete Reference J2EE by James Keogh mcgraw publication
3. Professional Java Server Programming by Subrahmanyam Allamaraju, Cedric Buest Wiley Publication
4. JDBC™ API Tutorial and Reference, Third Edition, Maydene Fisher, Jon Ellis, Jonathan Bruce, Addison Wesley

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

1. Elsevier Journal on Computer Languages, Systems, and Structures
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/

SELF-LEARNING EXERCISES:

1. https://www.tutorialspoint.com/

2. https://www.geeksforgeeks.org/introduction-java-servlets/

Course Title	Advanced Algorithms				Course Type	Theory	
Course Code	M22TC0105	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**	**42**	**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 to 5	1,2,3
CO2	Experiment with different data structures for real time application	1 to 5	1,2,3
CO3	Analyse the search and graph algorithms for real world applications	1 to 5	1,2,3
CO4	Make use of Number Theoretic Algorithms and Probabilistic and Randomized Algorithms in real world applications.	1 to 5	1,2,3
CO5	Make Use of randomization in designing and analysis of efficient algorithms.	1 to 5	1,2,3
CO6	Analyse the algorithms for basic numerical and probabilistic problems.	1 to 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			√			
CO5			√			
CO6				√		

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
CO5	3	2	2	2	3							3	1	1
CO6	3	2	3	2	2							3	2	1

COURSE CONTENTS:

UNIT-1

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

UNIT-2

Application of Data Structures: Application of stack – implementation of function call, infix, post fix evaluation, reverse a string. Application of Queue – implementation of system calls, like, printer node, queuing system etc., using dynamic approach.

Sorting and searching algorithms: merge sort, quick sort, binary search with analysis

String matching algorithms: naiive string, Rabin Karp algorithm, string matching with finite automata, Knuth - Morris – Pratt algorithm, Boyer – Moore algorithm

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. HCormen, C E Leiserson, R1Rivest and C Stein, "Introduction to Algorithms", Prentice-Hall of India, 2010.
2. M. Kenneth A. Berman, Jerome Paul "Algorithms", Cengage Learning, 2002.
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson, 2016

REFERENCE BOOKS:

1. AnanyLevitin, "Introduction to the Design & Analysis of Algorithms", Pearson, 2013
2. Ellis Horowitz, SartajSahni, S. Rajasekharan, "Fundamentals of Computer Algorithms", 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
4. ACM Transactions on Algorithms
5. ACM Transactions on Modeling and Computer Simulation (TOMACS)
6. Transactions on Parallel and Distributed Systems

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	**IoT Design and Cyber Physical Systems**				**Course Type**	**Theory**	
Course Code	**M22TC0106**	**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**	**42**	**50**	**50**

COURSE OVERVIEW:

This course introduces cyber physical system to the students which focused on different ubiquitous applications we interact in our day to day life ranging from simple system to mission critical applications. Such ubiquitous physical systems are controlled or integrated with the software to provide crucial functionality to various applications such as railway, avionics, automobile, healthcare, industrial, power or nuclear automation. Due to complicated

interaction/integration with the real time systems and critical data processing makes cyber physical systems different from the embedded systems. This course aims to expose the student to cyber physical systems and provide a walk through the fundamentals, design and validation using real world examples.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basics of IoT Applications.
2. Illustrate the Physical design of IoT.
3. Demonstrate the developing applications through IoT tools.
4. Foster understanding through real-world applications related to IoT.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply IoT system concepts to solve real word problems	1 to 5,9,10	1,3
CO2	Present solution to automated systems to make life easier.	1 to 5, 9,10	1,3
CO3	Implement concepts of embedded systems and microcontroller enhance existing systems.	1 to 5, 9,10	2, 3
CO4	Develop concepts, logics towards solving an unknown problem research and industry.	1 to 5, 9,10	2
CO5	Enhance the basic principles of design and validation of CPS.	1 to 5, 9,10	1,3
CO6	Identify the Cyber Security Requirements	1 to 5, 9,10	1,3

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			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				3	3		3		3
CO2	3	3	2	2	1				3	3		3		3
CO3	3	3	1	1	1				3	3			3	3
CO4	3	3	3	1	2				3	3			3	
CO5	3	1	2	1	3				3	3		3		3
CO6	3	1	2	1	3				3	3		3		3

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

COURSE CONTENT

UNIT- I

Introduction to IoT: Brief History and evolution of IoT, Definition of IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT. Communication models and APIs.

UNIT -II

Challenges in IoT IoT Services Platform: Functions and Requirements, Design challenges, Development challenges, Internet of Things Security and Privacy, Other challenges. Developing IoTs Introduction to Python and IoT tools, developing applications through IoT tools, developing sensor based application through IoT platform

UNIT – III

Introduction: Cyber-Physical System: Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

CPS Platform components: CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT – IV

Security of Cyber-Physical Systems: Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Ddvanced Techniques in CPS Securities.

CPS Application: Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber Physical Systems, WSN based Cyber-Physical Systems, Smart Cities

TEXT BOOKS:

1. Adrian McEwen, "Designing the Internet of Things", Wiley.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill 7. Cuno Pfister,
3. "Getting Started with the Internet of Things", O Reilly Media.

REFERENCE BOOKS:

1. Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann, "Interconnecting Smart Objectswith IP: The Next Internet" Elsevier.
2. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
3. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.
4. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2017
5. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015

JOURNALS/MAGAZINES:

1. IEEE – Internet of Things Journal. ...
2. Elsevier – Internet of Things. ...
3. Inderscience – International Journal of Internet of Things and Cyber-Assurance. ...
4. IEEE – Wireless Communications. ...
5. IEEE – Transactions on Wireless Communications. ...
6. Springer – Wireless Networks (SpringerNature) ...
7. Wiley – Information Systems Journal.
8. https://www.inderscience.com/jhome.php?jcode=ijitca
9. https://www.inderscience.com/jhome.php?jcode=ijitca
10. https://www.igi-global.com/journal/international-journal-hyperconnectivity-internet-things/157228

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.classcentral.com/course/swayam-programming-in-java-12930
3. https://swayam.gov.in/explorer?searchText=java

SELF-LEARNING EXERCISES:

1. Using Arduino IDE
2. Programming with Raspberry Pi Board
3. Identifying similar Micro controller boards.
4. Collect the technical specifications of all available micro controller boards.

Assignment Questions

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		

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 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.	Arduino	Understanding working of L239D motor driver
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.	Arduino	Understanding Access control system
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.	Arduino	Understanding WiFi working principle
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).	Arduino	Understanding the automated safety features in cars.

5.	To design 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.	Arduino	Creation of interfaces and its usage.
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	Arduino Yun	Creation of string class and its usage
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.	Raspberry Pi, Python	Understanding the working principle of temperature controller.

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	Arduino / Python	Understanding the working principle for decision-based system
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.	Arduino	Knowledge on Computer Vision
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 your own car robot based on GPS.	Arduino / python	Understanding the working principal of GPS

Course Title	**Research Methodology and IPR**				**Course Type**	**Practice**
Course Code	**M22TC0107**	**Credits**	**3**		**Class**	**I Semester**
	TLP	Credits	Contact Hours	Work Load	Total Number of	Assessment in

Course Structure	Theory	3	3	3	Classes Per Semester	Weightage	
	Practice	-	-	-	Practice	CIE	SEE
	-	0	-	-			
	Total	3	3	3	**42**	**50**	**50**

COURSE OVERVIEW:

In this course the important aspects of research is delivered. The intent of the course is to make students aware of the details associated with formal research and to help students overcome common misconceptions that may be present in their minds. By going through this course, students are likely to be able to take up research activities in a more systematic and formal manner right from the beginning.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the significance of effective research and its challenges
2. Creating interactive steps in developing technical document.
3. To make them familiar with the art of using different research methods and techniques.
4. Enable researchers, in developing the most appropriate methodology for their research studies

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Analyze efficiency in development and use of technical document	1 to 11	1,2,3
CO2	Perform a comparative study on different methods of data collection	1 to 11	1,2,3
CO3	Perform systematic literature review based on type of technical document creation.	1 to 11	1,2,3
CO4	process and analyze the data along with the theory of estimation	1 to 11	1,2,3
CO5	context of planning and development of research methodology	1 to 11	1,2,3
CO6	To have understanding on goal and deliver of the document.	1 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		√	√	√	√	√

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO2	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO3	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO4	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO5	2	3	3	2	2	2	2	2	2	2	2	3	3	3
CO6	2	3	3	2	2	2	2	2	2	2	2	3	3	3

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

COURSE CONTENT

UNIT – 1

Introduction to Research Methodology: Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems encountered by researchers in India. SWOT Analysis, Selection of Supervisor, research Execution.

UNIT – 2

Technical Documentation & Guidelines - Identification of objective, goals of the document. Types of documents, Introduction to navigational structure of document, Overview on Technical documentation Template, Data collection, Creation of Hypothesis based on research topic, interactive steps to write technical document, identify the research gap from the literature review, Documentation plan, 30: 70 rule to provide feedback, Maintain the Technical Glossaries, Safety Check for documentation, navigation audit, usability, create and maintain update schedule.

UNIT – 3

Research Design: What is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design.

UNIT – 4

Interpretation and Report Writing: Technique of Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Interactive steps to write research paper, Steps to draft the research proposal and Steps to draft the Design/Product/Application patent.

TEXT BOOKS:

1. Whitaker JC, Mancini RK. Technical documentation and process. CRC Press; 2012 Oct 24.
2. Kothari CR. Research methodology: Methods and techniques. New Age International; 2004. ISBN (13) : 978-81-224-2488-1

REFERENCE BOOKS:

1. Schultz SK, Darrow J, Kavanagh F, Morse M. The Digital Technical Documentation Handbook. Digital Press; 2014 Jun 28.

SWAYAM/NPTEL/MOOCs:

1. Introduction to Research, Prathap Haridoss & Team, IIT Madras, nptel.

SELF-LEARNING EXERCISES:

Perform SWOT analysis on the selected research topic

Course Title	**Advanced Machine Learning Lab**				**Course Type**	**Practice**
Course Code	**M22TC0108**	**Credits**	**1**		**Class**	**I Semester**
	TLP	Credits	Contact Hours	Work Load	Total Number of	Assessment in

Course Structure	Theory	1	2	2	Classes Per Semester	Weightage	
	Practice	-	-	-	Practice	CIE	SEE
	-	0	-	-			
	Total	**1**	**2**	**2**	**28**	**25**	**25**

COURSE OVERVIEW:

In this course you will learn how to program in R and how to use R for machine learning. It gives an overview of many concepts, techniques and algorithms in machine learning, beginning with topics such as classification and linear regression and ending up with more recent topics such support vector machines.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Apply the mathematical and statistical perspective of machine learning algorithms through R programming.
2. Implement machine learning algorithms using R programming.
3. Analyze the data to perform classification and regression.
4. Evaluate clustering algorithms using R programming.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Implement s-algorithm and candidate elimination using R programming	1 to 5,8,9,11	1
CO2	Analyze more advanced machine-learning algorithms to scenarios such perceptron.	1 to 5,8,9,11	1,2
CO3	Predicting data analysis outcome using R programming	1 to 5,7,9,10,1	1,2,3
CO4	Evaluate the efficiency of linear classifier	1 to 5,7,9,11	1,2,3
CO5	Apply naïve bayes algorithm on get hub data set.	1 to 5,8,9,11	1

CO6	Analyze various clustering algorithm	1 to 5,8,9,11	1,2

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				✓		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	1	2	3			2	2		2	2		
CO2	3	2	2	2	3			2	2		2	3	2	
CO3	3	2	2	3	3		2		2	2	2	3	3	1
CO4	3	2	2	3	3		2		3		3	3	3	1
CO5	2	1	1	2	3			2	2		2	2		

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

Sl.No.	List of Programs	Tools and Techniques	Expected Skill /Ability

1.	PROCEDURE TO INSTALL R STUDIO: It 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 Packages.	R STUDIO	R Programming skills
2.	FIND-S ALGORITHM: In Machine Learning Concept learning can be termed as "a problem of searching through a predefined space of potential hypothesis for the hypothesis that best fits the training examples. Implement the Find-S algorithm that starts with the most specific hypothesis.	R STUDIO	R Programming skills
3.	CANDIDATE ELIMINATION ALGORITTHM: The candidate elimination algorithm incrementally builds the version space from most general hypothesis to most specific hypothesis. Implement candidate elimination algorithm that considers positive instances and negative instances.	R STUDIO	R Programming skills
4.	LINEAR REGRESSION: It is regression technique which tries to fit all possible values. Builds a linear relation. Consider any dataset to implement linear regression for analyze the data, do possible data preprocessing and data exploration.	R STUDIO	R Programming skills
5.	NAIVE BAYES: It is a probabilistic approach undergoes bayes rule. Apply Navie Bayes algorithm using Get hub dataset for classification model on Flowers.	R STUDIO	R Programming skills
6.	KNN: It is mainly used for classification predictive problems. Select the number K of the neighbors. Calculate the Euclidean distance of K number of neighbors.	R STUDIO	R Programming skills

7.	K-MEANS: K-Means Clustering is an Unsupervised Learning algorithm, which groups the unlabeled dataset into different clusters. Implement KNN to calculate the variance and place a new centroid of each cluster	R STUDIO	R Programming skills
8.	APRIORI ALGORITHM: The Apriori algorithm uses frequent item sets to generate association rules, and it is designed to work on the databases that contain transactions. Determine the support of item sets in the transactional database and select the minimum support and confidence.	R STUDIO	R Programming skills

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

Course Title	Mini Project				Course Type	Practice	
Course Code	M22TC0109	Credits	2		Class	I 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	Practice	CIE	SEE
	-	0	-	-			
	Total	**2**	**4**	**4**	**56**	**25**	**25**

COURSE OVERVIEW:

The research based mini project is focused at providing the platform for students to enhance their research aptitude and develop the skills they require for developing the trending applications using the latest technologies. Additionally, this course gives a platform to students to showcase their talent by doing innovative projects that strengthen their profile making themselves employable in various domains.

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 will be allotted guides based on their area of interest.
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 (review-1 presentation (progress)), and review-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.

II Semester
Syllabus

Course Title	Cloud Computing Tools				Course Type	Theory	
Course Code	M22TCS211	Credits	3		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	-	-	-	Theory	CIE	SEE
		-	-	-			
	Total	**3**	**3**	**3**	**42**	**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 to 5,9	1,2,3
CO2	Develop Cloud based applications with AWS	1 to 5,9	1,2,3
CO3	Experiment applications deployment using OpenNebula	1 to 5, 8 to 11	1,2,3
CO4	Create Cloud based scenarios using Eucalyptus	1 to 5, 8 to 11	1,2,3
CO5	Deploy cloud-based applications using OpenNebula.	1 to 5, 8 to 11	1,2, 3
CO6	Develop cloud-based applications using Eucalyptus.	1 to 5, 8 to 11	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			√			
CO5			√			
CO6			√			

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

CO4	3	3	2	2	3			1	3	2	2	1	3	3
CO5	3	3	2	2	3			1	3	2	2	1	3	3
CO6	3	3	2	2	3			1	3	2	2	1	3	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/

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Web Technologies</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M22TCS212</td><td>Credits</td><td colspan="2">3</td><td>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 rowspan="2">Total Number of ClassesPer Semeste</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>-</td><td>-</td><td>-</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>42</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. To understand the concept of XML and to implement Web services using XML based standards.
3. Discuss web service in terms of WSDL and UDDI.
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 to 5	1,2,3
CO2	understand basic principles of service oriented architecture	1 to 5	1,2,3
CO3	Explain the link between the concepts of services and business processes and discuss and critique related standards.	1 to 5	1,2,3
CO4	Develop and deploy web services and cloud applications using appropriate Microsoft technologies.	1 to 5,8	1,2,3
CO5	Analyze the problems associated with tightly coupled distributed software architecture.	1 to 5	1,2,3
CO6	Optimize the web applications and mechanisms to make it more secure.	1 to 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			√			
CO5			√			
CO6			√			

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
CO5	2	2	3	2	2							3	2	3
CO6	2	3	3	2	1							3	2	2

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

Architecting Web Services: Business motivations for web services, B2B, B2C, Technical motivations, limitations of CORBA and DCOM, Service-oriented Architecture (SOA), Architecting web services, Implementation view, web services technology stack, logical view, composition of web services, deployment view, from application server to peer to peer, process view, life in the runtime.

UNIT-3

Web Services Building Blocks: Transport protocols for web services, messaging with web services, protocols, SOAP, describing web services, WSDL, Anatomy of WSDL, manipulating WSDL, web service policy, Discovering web services, UDDI, Anatomy of UDDI, Web service inspection, Ad-Hoc Discovery, Securing web services.

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", Pearson Education, 2009.
3. jQuery Fundamentals by Rebecca Murphey
4. Ron Schmelzer et al. "XML and Web Services", Pearson Education, 2002.

REFERENCE BOOKS:

1. Stuttard D., Pinto M., "The Web Application Hackers Handbook", Wiley India Pvt. Ltd, 2016.
2. DeitelH.M., Deitel P.J., "Internet & World wide Web: How to program", 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/

Course Title	Advanced Computer Architecture				**Course Type**	Theory	
Course Code	M22TCS213	**Credits**	3		**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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

Computer architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance, and cost goals. In this course, student will learn the Theory of Parallelism, Hardware technology, bus & cache mechanism. The students also look into the parallel and scalable architectures available.

COURSE OBJECTIVES:

1. To understand the need for theory of parallelism.
2. To understand the hardware technology.
3. To learn about the bus and cache mechanism.
4. To learn parallel computer scalable architectures.

COURSE OUTCOMES:

At the end of the course, the students should be able to:

CO#	Course Outcomes	Pos	PSOs
CO1	Describe the concepts of parallel computing and hardware technologies.	1 to 5	1,2,3
CO2	Use the knowledge of the different memory technology.	1 to 5	1,2,3
CO3	Understand parallel scalable computer architectures.	1 to 5	1,2,3
CO4	Distinguish the different pipeline architectures.	1 to 5	1,2,3
CO5	Compare and contrast the parallel architectures	1 to 5	1,2,3
CO6	Demonstrate about the Multithreaded Architectures.	1 to 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				√		
CO5				√		
CO6			√			

COURSE ARTICULATION MATRIX

CO#	Program Outcomes													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	2							3	3	3
CO2	3	3	2	3	2							3	3	3
CO3	3	2	3	2	2							3	3	3
CO4	3	3	3	2	2							3	3	3
CO5	3	2	3	3	2							3	3	3
CO6	3	3	3	2	2							3	3	3

COURSE CONTENTS:

UNIT-1

Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer ,Multivector and SIMD Computers ,PRAM and VLSI Models, Program and Network Properties ,Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.

UNIT-2

Theory of Parallelism: Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.

UNIT-3

Bus, Cache, and Shared Memory ,Bus Systems ,Cache Memory Organizations ,Shared Memory Organizations ,Sequential and Weak Consistency Models ,Pipelining and Superscalar Techniques ,Linear Pipeline Processors ,Nonlinear Pipeline Processors ,Instruction Pipeline Design ,Arithmetic Pipeline Design.

UNIT-4

Parallel and Scalable Architectures: Multiprocessors and Multicomputers ,Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multicomputers ,Message-Passing Mechanisms ,Multivector and SIMD Computers ,Vector Processing Principles ,Multivector Multiprocessors ,Compound Vector Processing ,SIMD Computer Organizations ,Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, Fine-Grain Multicomputers, Scalable and Multithreaded Architectures, Dataflow and Hybrid Architectures.

Text Books:

1. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, McGraw Hill Education 3/e. 2015

Reference Books:

1. John L. Hennessy and David A. Patterson, Computer Architecture: A quantitative approach, 5th edition, Morgan Kaufmann Elseveir, 2013

JOURNALS/MAGAZINES

1. IEEE Transactions on Computers
2. ACM Journal of Computer Systems
3. Elsevier Journal of microprocessor and microcomputers

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc22_cs110/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs62/preview

Course Title	Big Data and Analytics				Course Type	Theory	
Course Code	M22TCS221	Credits	3		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	-	--		Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

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 to 5	1,2,3
CO2	Apply Big Data Processing with MapReduce and Batch Analytics with Apache Spark to simple real world problems.	1 to 5	1,2,3
CO3	Implement Real-Time Analytics with Apache spark in real world Applications.	1 to 5	1,2,3
CO4	Develop data models for real world stream processingApplications	1 to 5	1,2,3
CO5	Analyze big data processing on large datasets using big data analytics tools.	1 to 5, 9 to 11	1,2, 3
CO6	Understand the theoretical concepts and various delivery models of Cloud Computing.	1 to 5, 9 to 11	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			√			
CO5			√			
CO6			√			

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
CO5	3	2	3	3	3				3	2	2	2	3	3
CO6	3	2	3	3	3				3	2	2	2	3	3

COURSE CONTENTS:

UNIT–1

Introduction: 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: TheMapReduce framework, MapReduce job types: Single mapper jobs, Single mapper reducer jobs, Multiple mappers reducer jobs; MapReduce patterns: Aggregation patterns, Filtering patterns, Join patterns.

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

UNIT–3

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

Batch Analytics with Apache Flink: Introduction to Apache Flink.

UNIT-4

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

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

SELF-LEARNING COMPONENT:

Concept of AWS and its Services.

TEXT BOOKS:

1.Sridhar Alla, “Big Data Analytics with Hadoop 3”, Packt Publishing Ltd, 2018

2. SeemaAcharya, SubhashiniChellappan, “Big Data and Analytics”, Wileyindia pvt ltd, 2015.

REFERENCE BOOKS:

1. Deka, Ganesh Chandra Mazumder, Sourav Singh Bhadoria, Robin “ Distributed Computing in Big Data Analytics – Concepts”, Springer International Publishing 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 Anbalytics
2. IEEE Transactions on Big Data and Anbalytics

3. Springer Jounal of Big Data and Anbalytics
4. ACM Transactions on Knowledge Discovery in Data (TKDD).
5. SIGKDD Explorations, a magazine of the SIGKDD, the data miners professional group.
6. Data Mining and Knowledge Discovery journal (now published by Springer).

SWAYAM/NPTEL/MOOCs:

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

<table>
<tr><td>Course Title</td><td colspan="4">Wireless and Mobile Networks</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M22TCS222</td><td>Credits</td><td colspan="2">3</td><td>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 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>3</td><td>3</td><td>3</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>42</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

In this course, students examine fundamental concepts of mobile cellular communications and specifics of current and proposed U.S. cellular systems. Topics include frequency reuse, call processing, propagation loss, multipath fading and

methods of reducing fades, error correction requirements and techniques, modulation methods: FDMA, TDMA, and CDMA techniques, microcell issues, mobile satellite systems and IMT-2000

COURSE OBJECTIVE (S):

The objectives of this course are to

1 Introduce of wireless communication and mobile communication standards.

2. Provide understanding of advanced multiple access techniques, Mobile radio Propagation Models and modulation techniques

3. Provide understanding of digital cellular systems (GSM, CDMA, GPRS, W-CDMA etc.)

4. Discuss various applications using the wireless technologies

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand principles of wireless communication and, various mobile network architecture.	1 to 5	1,2,3
CO2	Analyze the various Modulation techniques for Mobile Radio.	1 to 5	
CO3	Analyze the information theoretical aspects (such as the capacity) of wireless channels.	1 to 5	1,2,3
CO4	Realize various wireless and mobile cellular communication systems	1 to 5	1,2,3
CO5	Develop applications using the wireless technologies.	1 to 5	1,2,3
CO6	Implement practical mobile applications	1 to 5	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					√	

COURSE ARTICULATION MATRIX

CO#/ POs	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
CO5	3	3	3	3	1							3	3	3
CO6	3	3	3	3	2							3	3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

INTRODUCTION TO WIRELESS COMMUNICATIONS: History and evolution of mobile radio systems. Types of mobile wireless services/systems-Cellular, WLL, Paging, Satellite systems, Standards, Future trends in personal wireless systems. 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.

UNIT – 2

CELLULAR CONCEPTS AND SYSTEM DESIGN FUNDAMENTALS: Cellular concept and frequency reuse, Multiple Access Schemes, channel assignment and handoff, Interference and system capacity, Trunking and Erlang capacity calculations.

UNIT – 3

MOBILE RADIO PROPAGATION MODELS: Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and Base band impulse respond models, parameters of mobile multipath channels, Antenna systems in mobile radio.

UNIT – 4

MODULATION TECHNIQUES: Overview analog and digital modulation techniques, Performance of various modulation techniques-Spectral efficiency, Error-rate, Power Amplification, Equalizing Rake receiver concepts, Diversity and space-time processing, Speech coding and channel coding. Multiple Access Techniques-FDMA, TDMA and CDMA systems.

TEXT BOOKS:

1. S. Rappaport, Wireless digital communications; Principles and practice, Prentice Hall, NJ, 1996.

2. Schiller, Mobile Communications; Pearson Education Asia Ltd., 2000.

3. Jochen3. Schillier, “Mobile Communications”, Pearson publishers, 2004.

REFERENCE BOOKS:

1. Feher, Wireless digital communications, PHI, New Delhi, 1999.

2. C. Y. Lee, Mobile communications engineering: Theory and Applications, Second Edition, McGraw Hill, New York.1998.

JOURNALS/MAGAZINES

1. IEEE Transactions on Vehicular Technology

2. IEEE Transactions on Wireless Communications

3. Springer Wireless Networks Journal

4. Elsevier Journal of Wireless and Mobile Networks

5. IEEE Transactions on Wireless and Mobile Networks

6. Springer Journal 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/

SELF-LEARNING EXERCISES:

Operational systems, Wireless networking, design issues in per-sonal wireless systems

<table>
<tr><td>Course Title</td><td colspan="4">Design Principles of User Interface/User Experience</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M22TCS223</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="3">Course</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>-</td><td>-</td><td>-</td><td></td><td>CIE</td><td>SEE</td></tr>
</table>

Structure	-	0	-	-	Theory		
	Total	**3**	**3**	**3**	**42**	**50**	**50**

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 to 7	1,2,3
CO2	Implement the UI/UX design process and evaluate UID.	1 to 5,7	1,2,3
CO3	Develop applications using various Interaction styles including Direct Manipulation and Virtual Environment..	1 to 6	1,2,3
CO4	Elaborate the command, natural languages and issues in design for maintaining QoS.	1 to 7	1,2,3
CO5	Elaborate the command, natural languages and issues in design for maintaining QoS.	1 to 7	1,2,3
CO6	Develop applications using various Interaction styles including Direct Manipulation and Virtual Environment	1 to 6	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				√		
CO5				√		
CO6			√			

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	1	1					2	2	3
CO2	3	3	2	2	1		2					2	3	3
CO3	3	3	2	2	3	1						3	2	3
CO4	2	3	2	3	3	1	1					2	3	3
CO5	2	3	2	3	3	1	1					2	3	3
CO6	3	3	2	2	3	1						3	2	3

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", Pearson Education, 2010.

2. Alan Dix, Janet Finalay, Gregory D AbiwdmRusselBealel, “Human-Computer Interaction, Pearson Education, 2008.

REFERENCE BOOKS:

1. Eberts. ” User Interface Design”, Prentice Hall, 1994.
2. Wilber O Galitz, “ The Essential Guide to User Interface Design- An Introduction to GUI Design, Principles and Techniques”, Wiley-Dreamtech India Pvt Ltd, 2011

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/

Course Title	**Advanced Unix System Programming**	Course Type	Theory

Course Code	M22TCS231	Credits	3		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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

In this course the study of advanced UNIX system programming. This Advanced Unix Programming an in-depth training course for software developers on UNIX system programming facilities.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals and structure of UNIX Operating System
2. Illustrate the use of process management
3. Describe UNIX Signal and Demon process
4. Understand the Interposes communication and Sockets

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Outline the fundamentals of UNIX Operating System	1 ,2,5,9,10	1,2,3
CO2	Understand different Unix file I/O and multi-tasking	1,2,4,5,9,10	1,2,3
CO3	Apply Unix process control	1,4,5,9,10	1,2,3
CO4	Demonstrate the usage of signals	1,4,5,9,10	1,2,3
CO5	Explain Inter process communication	1,4,5,9,10	1,2,3
CO6	Implement Sockets for data transfer.	1,2,4,5,9,10	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			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1			3				3	3		3	3	1
CO2	3	2		2	3				3	3		3	3	3
CO3	3			3	3				3	3		3	3	2
CO4	3			3	2				3	3		3	3	1
CO5	3			2	3				3	3		3	3	2
CO6	3	2		3	3				3	3		3	3	3

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

COURSE CONTENT

UNIT – 1

Introduction and File I/O: UNIX introduction and Architecture. and UNIX Standardization ISO C, IEEE POSIX. ISO Limits, POSIX limits, SXI limits File descriptors. File I/O functions open, openat, create, close, lseek, read and write, stat, fstat, fstatat, lstat, hardlink and softlink, ls-l. multitasking system.

UNIT – 2

Process and Programming : Process Origin. INIT, login and sh Processes. Process Execution Modes, Process synchronization, Process termination. System calls for process management Pipes. Parallel computing, Threads, threads operation, thread management functions, thread examples, thread synchronization, programming projects

UNIT – 3

Signals and Daemon Processes: Signals and interrupts, signal processing , steps, exception, signal functions Daemon Processes: Introduction, Daemon Characteristics, Coding Rules, Error Logging, Single- instance daemons, Daemon conventions; Client-Server Model.

UNIT – 4

Interprocess Communication and Network IPC-Sockets: Introduction, Pipes and FiFOs, Programming Project – Implement an IPC for messages. Network Programming, Socket introduction, socket addressing and socket options, Socket programming . Domain Sockets Unique connections. Passing file descriptors.

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",3rd edition, Addison Wesley

REFERENCE BOOKS:

1. Kay A. Robbins and Steven Robbins, "UNIX Systems Programming: Communication, Concurrency, and Threads", Prentice Hall,2015

2. W.Richard Stevens, "UNIX Network Programming, Interprocess Communications(Paperback)", Addison-Wesley. 2014

JOURNALS/MAGAZINES

1. https://www.automationjournal.org/download/advanced-unix-programming-2/.
2. Elsevier Journal of Unix System Programming
3. IEEE Transactions on Unix System Programming
4. Springer Journal of Unix System Programming

SWAYAM/NPTEL/MOOCs:

9. https://www.udemy.com/ Unix System Programming
10. https://www.coursera.org/learn/ Unix System Programming
11. https://nptel.ac.in/courses/106107129/

SELF-LEARNING EXERCISES:

1. More exploration on GitHub

Course Title	Mobile Application Development				Course Type	Theory	
Course Code	M22TCS232	Credits	3		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semeste	Assessment in Weightage	
	Theory	3	3	3			
	Practice	-	-	-		CIE	SEE
	-	0	-	-	Theory		
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

This course is concerned with the development of applications on mobile and wireless computing platforms. Android will be used as a basis for teaching programming techniques and design patterns related to the development of standalone applications and mobile portals to enterprise and mcommerce systems. Emphasis is placed on the processes, tools and frameworks required to develop applications for current and emerging mobile computing devices. Students will work at all stages of the software development life-cycle from inception through to implementation and testing. In doing so, students will be required to consider the impact of user characteristics, device capabilities, networking infrastructure and deployment environment, in order to develop software capable of meeting the requirements of stakeholders.

COURSE OBJECTIVE (S):

1. Explain the android SDK.
2. Illustrate about the basic understanding of Android application development
3. Demonstrate the use of knowledge of Android Studio development tool.
4. Adapt to learn new mobile technologies.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	CourseOutcomes	POs	PSOs
CO1	Understand Android OS, gradle, Android Studio and the concepts of mobile programming that make it unique from programming for other platforms.	1 to 5,11	1,2,3
CO2	Identify the mobile applications on their design pros and cons.	1 to 5,11	1,2,3
CO3	Evaluate the rapid prototyping techniques to design and develop sophisticated mobile interfaces.	1 to 5,11	1,2,3

CO4	Solve the Program mobile applications for the Android operating system that use basic and advanced phone features.	1 to 5,11	1,2,3
CO5	Demonstrate the Android marketplace for distribution.	1 to 5,11	1,2,3
CO6	Analysis working with different types of resources.	1 to 5,11	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	**Bloom'sLevel**					
	Remember (L1)	**Understand (L2)**	**Apply (L3)**	**Analyze (L4)**	**Evaluate (L5)**	**Create (L6)**
CO1		√				
CO2			√			
CO3					√	
CO4			√			
CO5					√	
CO6			√			

COURSE ARTICULATIONMATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**O6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3						3	3	3	3
CO2	3	3	3	3	3						3	3	3	3
CO3	3	2	3	3	3						3	3	3	3
CO4	3	3	3	3	3						3	3	3	3
CO5	3	3	3	3	3						3	3	3	3
CO6	3	2	3	3	3						3	3	3	3

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

COURSE CONTENT

THEORY

UNIT - 1

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Android Architecture, Understanding Anatomy of Android Application, Android Manifest file, Android Activity Life cycle, Different XML files in Android.

UNIT - 2

Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Edit Text, Text View, Button, Check Box, Image view ,Switch, Toggle Button, Radio Button and Radio Group ,Rating Bar, Spinner, Progress Bar , Toast in android, picker, Date picker, Calendar view.

UNIT - 3

Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation, Adapters in android, Parsing JSON and XML Files.

UNIT- 4

Publishing Android application, SQLite with Android Application, Messaging In android, Email sending in Android, Introduction to Firebase

TEXT BOOKS:

1. T1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)

REFERENCE BOOKS:

1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

JOURNALS/MAGAZINE:

https://ieeexplore.ieee.org/document/6104696

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106106156
2. https://onlinecourses.nptel.ac.in/noc20_cs52/preview
3. https://www.coursera.org/learn/aadcapstone
4. https://onlinecourses.swayam2.ac.in/nou21_ge41/preview
5. https://firebase.google.com/

SELF-LEARNING EXERCISES:

1. Android Development

Course Title	Image Processing and Analysis				**Course Type**	Theory	
Course Code	M22TCS233	**Credits**	3		**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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

Image processing, analysis, and machine vision are an exciting and dynamic part of cognitive and computer science. The domain is characterized by a maturing of the field and significant growth of active applications; remote sensing, technical diagnostics, autonomous vehicle guidance, biomedical imaging (2D, 3D, and 4D) and automatic surveillance

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand differences between computer vision and image processing.

2. Understand how images are represented.

3.Make use of mathematical concepts in illustrating the processing of images.

4.Understnad and discuss the object recognition through algorithmic approach.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	**Course Outcomes**	**POs**	**PSOs**

CO1	Define and understand computer vision and its approach	1 to 6,8 to 11	1,2,3
CO2	Discuss and identify the representation of a digital image and the properties associated with it	1 to 6,7,9 to 11	1,2,3
CO3	Relate the different data structures that are used in image processing	1 to 6,10	1,2,3
CO4	Discuss and understand the need of focusing on region of interest through segmentation	1 to 11	1,2,3
CO5	Use the understanding of various approaches used in object recognition	1 to 11	1,2,3
CO6	Express and explain various Pattern recognition methods in image understanding	1 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		√		√		

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1		1	2	1	1	3	3	3
CO2	2	3	1	2	2	1	1		1	2	2	3	3	3
CO3	2	1	2	2	2	1				1		3	3	3
CO4	2	3	1	3	2	1	2	2	1	2	2	3	3	3
CO5	2	2	2	2	1	3	3	1	2	2	3	3	3	3

CO6	2	2	3	3	2	3	2	1	3	1	2	3	3	3

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

COURSE CONTENT

UNIT – 1

Introduction-Motivation, why is computer vision difficult? Image representation and image analysis tasks.

The image, its representations and properties: Image representations a few concepts, Image digitization, Digital image properties

Data structures for image analysis: Levels of image data representation, Traditional image data structures, Hierarchical data structures

UNIT – 2

Image preprocessing: Pixel brightness transformations, Geometric transformations, Local pre-processing, Image smoothing, Edge detectors, Zero-crossings of the second derivative, Image restoration

Segmentation: Thresholding, Edge-based segmentation, Edge image thresholding, Edge relaxation, Border tracing, Hough transforms, Fuzzy connectivity

UNIT – 3

Object recognition: Knowledge representation, Statistical pattern recognition, Neural nets, Syntactic pattern recognition, Optimization techniques in recognition, Fuzzy systems, Boosting in pattern recognition, Random forests

UNIT – 4

Image understanding: Image understanding control strategies, SIFT: Scale invariant feature transform, RANSAC: Fitting via random sample consensus, Pattern recognition methods in image understanding

TEXT BOOKS:

1. Milan Sonka et.al. ," Image Processing, Analysis, and Machine Vision, Global Engineering: Timothy L. Anderson, 4th Edition, 2005.

2. Gonzalez and Woods, Digital Image Processing, 2nd Edition, Prentice Hall, 2008

REFERENCE BOOKS:

1. Alasdair Mc Andrew; Introduction to Digital Image Processing; Cengage learning; 2009.

2. J. G. Proakis; Introduction to Digital Signal Processing; PHI.

3 . IEEE transactions on image processing

4. ACM Transactions on image processing

JOURNALS/MAGAZINES

1. https://www.mdpi.com/journal/
2. https://ieeexplore.ieee.org
3. https://www.springer.com/journal/
4. https://ieeexplore.ieee.org/document/7990553

SWAYAM/NPTEL/MOOCs:

1.https://onlinecourses.swayam2.ac.in/cec20_cs03/preview

2.https://iiiier.org/NPTEL-Local-Chapter

SELF-LEARNING EXERCISES:

1. More exploration on GIThub

Course Title	Data Storage Technology and Network				Course Type	Theory	
Course Code	M22TCS241	Credits	3		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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

Data Centre Introduction, Site Selection and Environmental Considerations, Data Centre Design, IT Hardware, Cooling System Options and Environmental Control, Fire Protection and Security Systems. Storage Management, Major physical components of a disk drive and their functions, Concept of RAID, Networked Storage Evolution of networked storage, topologies of FCSAN, NAS, and IP-SAN, Managing Data Center Reasons for planned/unplanned outages, Impact of downtime, Securing Storage and Storage Virtualization Information Security, Critical security attributes for information systems, Storage security domains, Symmetric and Asymmetric storage virtualization in the Network.

COURSE OBJECTIVES:

The objectives of this course are to:

1. To gain knowledge and understand the design of a Data Centre.
2. To understand the best practice of design in the Data Centre.
3. To learn the options in the running of an efficient Data Centre.
4. To understand the value of data to a business, Information Lifecycle.
5. To learn solutions available for data storage.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
C01	Apply data centre design and storage requirements.	1 to 5	1,2,3
C02	Summarize the various types of storage and their properties.	1 to 5	1,2,3
C03	Develop physical and virtualization storage.	1 to 5	1,2,3
C04	Analyze the backup and archive with regard to recovery and business continuity.	1 to 5	1,2,3
CO5	Apply the concepts to different networked storage options for different application environments.	1 to 5	1,2,3
CO6	Analyze the concepts of storage security domains and common threats in each domain.	1 to 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			√			
CO5			√			
CO6			√			√

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**	**3**
CO2	2	3	3	2	3							**3**	**3**	**3**
CO3	3	2	2	2	3							**3**	**3**	**3**
CO4	3	3	2	2	3							**3**	**3**	**3**
CO5	3	2	2	3	3							**3**	**3**	**3**
CO6	3	3	2	2	3							**3**	**3**	**3**

COURSE CONTENTS:

UNIT I

Data Centre: Introduction, Site Selection and Environmental Considerations, Hierarchical or Layered Architecture, Architect Roles, Goals and Skills, Architecture Precursors.

Data Centre Design: Architecture Design and Standards Recommendations, Raised Access Floor and Design Best Practices, connecting the infrastructure with copper and fiber. IT Hardware, Cooling System Options and Environmental Control, Electrical Power Systems, Room Layout, Fire Protection and Security Systems, Building Automation and Energy Management Systems, Commissioning and Handover.

UNIT II

Storage Management: Introduction to Storage Technology, Storage Systems Architecture, Physical and logical components of a connectivity environment, Major physical components of a disk drive and their functions, Concept of RAID, different RAID levels and its components, high-level architecture and working of an intelligent storage system.

UNIT III

Networked Storage: Evolution of networked storage, Architecture, components, and topologies of FCSAN, NAS, and IP-SAN, need for long-term archiving solutions and describe how CAS fulfill the need, Appropriateness of the different networked storage options for different application environments.

Managing Data Center: Reasons for planned/unplanned outages, Impact of downtime, Difference between business continuity (BC) and disaster recovery (DR), RTO and RPO, Identification of single points of failure in a storage infrastructure and solutions to mitigate these failures, Architecture of backup/recovery and the different backup/recovery topologies, Key areas to monitor in a data center, Industry standards for data center monitoring and Management Key metrics to monitor storage infrastructure.

UNIT IV

Securing Storage and Storage Virtualization: Information Security, Critical security attributes for information systems, Storage security domains, Analyze the common threats in, each domain; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network

TEXT BOOKS:

1. Mauricio Arregoces, “Data Center Fundamentals”, Cisco Press, 1st edition, 2003.
2. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne. 2001.
4. Meeta Gupta, “Storage Area Network Fundamentals”, Pearson Education Limited, 2002

REFERENCE BOOKS:

1. G. Somasundaram, Alok Shrivastava, “Information Storage and Management”, EMC Education Series, Wiley Publishing Inc., 2011.
2. Gustavo Santana, “Data Center Virtualization Fundamentals: Understanding Techniques and Designs for Highly Efficient Data Centers with Cisco Nexus, UCS, MDS, and Beyond”, Cisco Press, 1st Edition, 2013

Course Title	Program Analysis				Course Type	Theory	
Course Code	M22TCS242	Credits	3		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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**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 to 5	1,2,3
CO2	Apply graph properties to data flow analysis, framework, assignments, functions and equations.	1 to 5	1,2,3
CO3	Design data flow analysis algorithm in round robin and iterative methods.	1 to 5	1,2,3
CO4	Develop various data flow analysis algorithms using the concept of GCC.	1 to 5	1,2,3
CO5	Appraise the process of deriving information about the run time behavior of a program without executing the program.	1 to 5	1,2,3
CO6	Estimate the semantic validity of a program (viz. type correctness based on inferencing, prohibiting the use of uninitialized variables etc.)	1 to 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			√			
CO5				√		
CO6					√	

COURSE ARTICULATION MATRIX

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
CO5	3	3	3	3	3							3	2	1
CO6	3	3	3	3	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, AmitabhaSanyal, and BageshriKarkare, "Data Flow Analysis: Theory and Practice", CRC Press,2009

REFERENCE BOOKS:

1. M. S. Hecht, "Flow Analysis of Computer Programs", ElsevierNorth-Holland Inc, 1977.
2. F. Nielson, 3. R. Nielson, and C. Hankin, " Principles of Program Analysis", Springer-Verlag, 1998.

JOURNALS/MAGAZINES:

1. Springer Journal on Program Analysis
2. Springer Journal 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/

Course Title	Data Preparartion and Analysis				**Course Type**	Theory	
Course Code	M22TCS243	**Credits**	3		**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	-	--		Theory	CIE	SEE
	-	0	-	-			

	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

In this course the fundamental concepts of Pre-processing, evaluation metrics are such as MSE, RMSE, MAD, R2, ANOVA, ROC, AUC and Chi-Square are discussed. Techniques for data analysis, preparing the data tables and understanding relationships and the python libraries such as numPy, pandas, seaborn, matplotlip and sciPy are also discussed.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1.Understand the data preprocessing in detail and the techniques of data exploration

2.Identify the different types of evaluation metrics and its needs in data analysis.

3.Describe the Data Tables and understanding relationship between the different types of data.

4.Discuss the need of data analysis and visualization methods using different packages in Python.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Understand the concepts of data preparation and pre-processing	1 to 5	1,2,3
CO2	Identify the different types of evaluation metrics for the data processing	1 to 5	1,2,3
CO3	Compare the different approaches for data preparation	1 to 5	1,2,3
CO4	Describe the relationships between the target and descriptive	1 to 5	1,2,3
CO5	Implement the data visualizing using seaborn and matplotlib python packages	1 to 5	1,2,3
CO6	Analysis and evaluate the data utilization using different python libraries	1 to 5	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				√	√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	3							3	3	2
CO2	2	2	2	3	2							3	3	2
CO3	2	2	3	2	2							3	3	3
CO4	2	1	1	3	2							3	3	3
CO5	3	3	3	3	1							3	3	3
CO6	3	3	3	3	2							3	3	3

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

COURSE CONTENT

UNIT – 1

Introduction- Overview - Sources of Data - Process for Making Sense of Data - Describing data: Overview - Observations and Variables - Types of Variables - Central Tendency - Distribution of the Data - Confidence Intervals - Hypothesis Tests - Pre-processing steps - Sampling - Resampling methods - Examples - case studies

UNIT – 2

Data Preparation Evaluation Metris: Confusion Matrix – Precision - Recall – Entropy - F-score – Z-Score- MAE - MSE - RMSE – MAD - R2 - ANOVA - ROC - AUC - Chi-Square – Cross-validation - Regularization - correlation -overfitting - underfitting - bias - variance - Tradeoff - Confidence intervals - P-value - Scedasticity - Normal distribution - Gaussian distribution -

UNIT – 3

Preparing Data Tables and Understanding Relationships: - Overview - Cleaning the Data - Removing Observations and Variables - Generating Consistent Scales Across Variables - New Frequency Distribution - Converting Text to Numbers - Converting Continuous Data to Categories - Combining Variables - Generating Groups - Preparing Unstructured Data - Visualizing Relationships Between Variables - Calculating Metrics About Relationships

UNIT – 4

Data Analysis: Knowledge Domains of the Data Analyst - Understanding the Nature of the Data - The Data Analysis Process - Quantitative and Qualitative Data Analysis - Pandas - numPy – SciPy - Matplotlib – Seaborn – Data Wrangling - case studies.

TEXT BOOKS:

1. Glenn J. Myatt, Wayne P. Johnson, "Making sense of data I - a practical guide to exploratory data analysis and data mining", Wiley, 2nd edition, 2014.

2. Hector Cuesta, "Practical Data Analysis - Transform, model, and visualize your data through hands-on projects, developed in open source tools", Packt 1st edition, 2013.

3. Wes McKinney, "Python for Data Analysis - Data Wrangling with Pandas, NumPy, and IPython", Oreilly, 2nd edition, 2018.

4. Peters Morgan," Data Analysis From Scratch With Python_ Beginner Guide using Python, Pandas, NumPy, Scikit-Learn, IPython, TensorFlow and Matplotlib", AI Sciences, 2016.

REFERENCE BOOKS:

1. Ethem Alpaydin, - Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014

2. Stephen Marsland, - Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

3. Tom M Mitchell, - Machine Learning‖, First Edition, McGraw Hill Education, 2013.

JOURNALS/MAGAZINES

1. https://www.springer.com/journal/11634
2. https://iopscience.iop.org/article/10.1088/1757-899X/1090/1/012053
3. https://www.springer.com/journal/41060

SWAYAM/NPTEL/MOOCs:

1. https://www.classcentral.com/course/swayam-data-analysis-and-decision-making-i-22946
2. https://onlinecourses.nptel.ac.in/noc21_mm09/preview
3. https://www.coursera.org/learn/data-analysis-with-python

SELF-LEARNING EXERCISES:

1. More exploration on GIThub

Course Title	Robotic Process Automation			Course Type	Theory
Course Code	M22TCS251	Credits	3	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	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

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 OBJECTIVE (S):

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 (COs)

After the completion of the 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 to 5	1,2,3
CO2	Apply appropriate Workflow Activities in UiPath Studio to automate the complex tasks using Flowchart and Sequence.	1 to 5	1,2,3
CO3	Build data table and data manipulation techniques in UiPath Studio to automate CSV / Excel workbook applications.	1 to 5	1,2,3
CO4	Design and Develop bot process using UI Explorer.	1 to 5	1,2,3
CO5	Design and Develop process to automate using Screen Scraping for complex applications.	1 to 5	1,2,3

CO6	Construct any real-world application by making use of the Automation features in RPA	1 to 5	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			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	3							3	3	2
CO2	3	3	3	2	3							3	3	2
CO3	3	3	3	2	3							3	3	2
CO4	3	3	3	2	3							3	3	2
CO5	3	3	3	2	3							3	3	2
CO6	3	3	3	2	3							3	3	2

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

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

TEXT BOOKS:

1. Alokmani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.

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

REFERENCE BOOKS:

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

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

JOURNALS/MAGAZINES

1. https://rpa-journal.org/
2. https://ieeexplore.ieee.org
3. https://www.sciencedirect.com/science/article/pii/S1877050921001393
4. https://ieeexplore.ieee.org/document/9001110./authors#authors

SWAYAM/NPTEL/MOOCs:

1. https://www.uipath.com/rpa/academy

https://www.coursera.org/specializations/roboticprocessautomation

3. https://www.udemy.com/topic/robotic-process-automation/

SELF-LEARNING EXERCISES:

1. Handling User Events
2. Assistant Bots

Course Title	Agile software development				Course Type	Theory	
Course Code	M22TCS252	Credits	3		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	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**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 to 5	1,2,3
CO2	Outline the fundamental principles and practices of Agile Software in real world problem	1 to 5	1,2,3
CO3	Analyze the core practices behind several specific agile methodologies.	1 to 5	1,2,3
CO4	Summarize the key Motivations for Iterative Development and meeting the requirements challenge Iteratively.	1 to 5	1,2,3
CO5	Make use of Building Blocks of DevOps methods in real world problems.	1 to 5	1,3
CO6	Develop the real world applications using DevOps tools.	1,3,4,5,9	1,3

BLOOM'S LEVEL OF THECOURSE OUTCOMES

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

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
CO5	3	2	2	3	2							3		3
CO6	3		2	3	2				2			3		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.

REFERENCE BOOKS:

1. Jeff Sutherland, “ Scrum: A revolutionary approach to building teams, beating deadlines, and boosting productivity”, Random House Business Books, 2014.
2. Mitch Lacey, “The Scrum Field Guide: Agile Advice for Your First Year”, Addison Wesley, 2012.
3. Martin C. Robert, Martin Micah, “Agile Principles, Patterns, and Practices in C#”, Prentice Hall, 2006.
4. Michael Huttermann, “DevOps for Developers, Integrate Development and Operations, the Agile Way”, Apress Publications. 2000(https://books.google.co.in/

JOURNALS/MAGAZINES:

1. Springer Journal on Agile Software Development
2. Springer Journal on Agile Software Development
3. Elsevier Journal on Agile Software Development
4. IEEE transactions on Agile Software Development Using Scrum.
5. ACM Transactions on DevOps.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Agile Software Development

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	M22TCS253	Credits	3		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	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**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 to 5,8	1,2,3
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	1 to 5,8	1,2,3
CO3	Utilize deep learning neural network model on real time applications like(face recognition, speech recognition)	1 to 5,8	1,2,3
C04	Apply object detection and recognition techniques to solve real world problems.	1 to 5	1,2,3
C05	Appraise back propagation neural networks for prediction to solve real world problem.	1 to 5,8	1,2,3
C06	Organize dataset using PCA and SVD	1 to 5,8	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			**√**			
C05					√	
C06						**√**

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
C05	3	2	3	2	3			1				3	3	2
C06	3	2	3	2	3			1				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 generativeModels.

TEXT BOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." MIT Press book in preparation,2015.
2. Duda, R.O., Hart, P.E., and Stork, "Pattern Classification", Wiley-Interscience,2001.

REFERENCES:

1. Theodoridis, S. and Koutroumbas, " Pattern Recognition", 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. Springer Journal on Deep Learning
3. Elsevier Journal on Deep Learning
4. Springer Journal of Machine Learning.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Deep Learning

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	M22TC0206	Credits	1		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semeste	Assessment in Weightage	
	Theory	1	2	2			
	Practice	-	-	-	Practice	CIE	SEE
	-	0	-	-			
	Total	**1**	**2**	**2**	**28**	**25**	**25**

COURSE OVERVIEW:

The course provides a fundamental awareness on cyber security platform to minimize the damage on the resources and ensure the protection during data transmission. Students develop expertise in defensive cybersecurity and a part of ethical hacking.

COURSE OUTCOMES:

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

CO#	Course Outcomes	Pos	PSOs
CO1	Understand the implementation of various techniques and security algorithm.	1 to 5,9,10	1,2
CO2	Analyze various active and passive attacks in the network	1 to 5,9,10	1,2

CO3	Apply various tools for secure data transmission and evaluate security postures in the network.	1 to 5,9,10	1,2,3
CO4	Investigate vulnerabilities, security threats and apply mechanisms to counter them.	1 to 5,9,10	1,2,3
CO5	Apply tools to analyze and investigate risks in the network	1 to 5,9,10	1,2,3
CO6	Demonstrate intrusion detection and preventions system using various open tools	1 to 5,9,10	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					✓	

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1				3	3		3	2	
CO2	3	3	2	2	1				3	3		3	3	
CO3	3	3	1	1	1				3	3		3	3	2
CO4	3	3	1	1	1				3	3		3	3	2
CO5	3	3	1	1	1				3	3		3	3	3

CO6	3	3	3	1	2				3	3		3	3	3

Practice:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	Implement the following substitution and Transposition techniques: • Caesar Cipher • Columnar Transposition Cipher • Substitution Cipher	Java /C++	Understand basics of Cryptography
2.	Implement Diffie-Hellman Algorithm to calculate key for sender and receiver.	Java / C++	Understand encryption and decryption process
3.	Implement following attacks: Brute Force Attack Dictionary Attack	Java / C++	Understand how to gain access into the system through the attacks
4.	Install rootkits and study its various options	RootKit	Analyze the software, gaining backdoor access, unauthorized access, falsify data;
5	Demonstrate message exchange and data transmission between server and client to demonstrate TCP and UDP models.	Wire Shark	Packet Sniffing, TCP/IP protocol analysis
6	Perform an experiment to Sniff Traffic using ARP Poisoning and DNS Poisoning.	Kali Linux	OS security, Convert IP address, Network sniffing
7	Implement a program in Java to generate digital signature and secure data storage and data transmission	GnuPG /Java	Digital Signature generation
8	Demonstrate Intrusion Detection and Prevention using Snort	Snort	Monitor network traffic in real time
	PART-B (Demo and Simulation)		

9.	Demonstrate how to assess and manage risk in the virtual network infrastructure using below concept: **Create a model** – add what all (server, router, firewall, services, etc.) you want to test. **Simulate an attack** – to find out if and when your system break. **Risk report** – based on simulation data, the actionable report will be generated which you can implement to lower	NeSSi2	Analyze and evaluate the network infrastructure
10	Evaluate the security posture of the network using infection monkey and virtual machine.	Infection monkey, Wireshark, Snort and Maltrail	Demonstrate the working principle of temperature controller.

TEXT BOOKS:

1. Rick Howard, Ryan Olson, James Graham, Cyber Security Essentials, 2016 edition.
2. Computer and Cyber Security Principles, Algorithm, Applications, and Perspectives, 2018

Course Title	Big data Analytics Lab				**Course Type**	Practice	
Course Code	M22TC0207	**Credits**	1		**Class**	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	1	2	2			
	Practice	-	-	-	Practice	CIE	SEE
	-	0	-	-			
	Total	**1**	**2**	**2**	**28**	**25**	**25**

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 big data analysis: Python, Hadoop HDFS, Hadoop MapReduce, Pig, Hive and Flume are demonstrated in this course through the demonstration of real life examples.

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.
3. Describe the implementation of Real-Time Analytics with Apache Hadoop in real world Applications.
4. Illustrate the working of Pig, Hive and Stream Processing and also discuss the fundamentals of Flume.

COURSE OUTCOMES:

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

CO#	Course Outcomes	POs	PSOs
CO1	Illustrate the fundamentals of Hadoop distributed file system and Big Data Analytics	1 to 5,9,10,11	1,2,3
CO2	Demonstrate Big Data Processing with MapReduce and Batch Analytics with Apache Hadoop to simple real world problems.	1 to 5,9,10,11	1,2,3
CO3	Design Real-Time Analytics with Apache Pig and Hive for real world Applications.	1 to 5,9,10,11	1,2,3
CO4	Develop data and processing models using Hadoop eco-system for real world Big data Applications	1 to 5,9,10,11	1,2,3
CO5	Design Real-Time Analytics incorporating the structured data model using Apache Hive to solve real world Big Data Analytics Applications.	1 to 5,9,10,11	1,2,3
CO6	Develop data and processing models using Hadoop eco-system for real world Big data Applications	1 to 5,9,10,11	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			√			

CO5			√			
CO6			√			

COURSE ARTICULATIONMATRIX

Course Outcomes	Program Outcomes														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3				1	1	1	1	3	3	3
CO2	3	3	3	3	3				2	1	2	3	3	3	3
CO3	3	3	3	3	3				2	1	2	3	3	3	3
CO4	3	3	3	3	3				3	3	2	3	3	3	3
CO5	3	3	3	3	3				2	1	2	3	3	3	3
CO6	3	3	3	3	3				3	3	2	3	3	3	3

PRACTICE:

SL. N.	Title of the Experiment	Tools and Techniques	Expected Skill/Ability
	PART-A		
1.	Install Hadoop in the following modes 1.1 Ubuntu OS Stand Alone Mode 1.2 Pseudo Distributed Mode 1.3 Pseudo Distributed Mode (YARN)	Windows/Linux OS, IDE	Understanding the process of Installation of Hadoop in different modes
2.	Perform the following File Management tasks in Hadoop 2.1 Create a directory in HDFS at given path(s). 2.2 List the contents of a directory 2.3 Upload and download a file in HDFS 2.4 See contents of a file 2.5 Copy a file from source to destination 2.6 Copy a file from/To Local file system to HDFS	Windows/Linux OS, IDE	Managing Files and performing operations on them on HDFS

	2.7 Move file from source to destination 2.8 Remove a file or directory in HDFS. 2.9 Display last few lines of a file 2.10 Display the aggregate length of a file.		
3.	Write a Word Count Map Reduce program to understand Map Reduce Paradigm.	Windows/Linux OS, IDE	Understanding the MapReduce Process
4.	Write a Weather Report POC-Map Reduce Program to analyses time-temperature statistics and generate report with max/min temperature.	Windows/Linux OS, IDE	Performing Big Data Analytics using MapReduce
5.	Implement the Matrix Multiplication with Hadoop Map Reduce.	Windows/Linux OS, IDE	Understanding the MapReduce Process
6.	Write Pig Latin scripts to sort, group, join, project, and filter your data.	Windows/Linux OS, IDE, Pig Tool	Performing Big Data Analytics using Pig Scripts
7	Write programs to demonstrate Hive Databases, Tables, Views, Functions and Indexes.	Windows/Linux OS, IDE, Hive Tables	Performing Big Data Analytics using Pig Scripts
	PART-B		
8	Implement and demonstrate any real life big data problem using any of the publicly available big data sets.	Windows/Linux OS, IDE, Hadoop-eco system	Literature Surveying, Project Implementation, Seminars, IPR Filing, Paper Publication

TEXT BOOKS:

1. Sridhar Alla, “Big Data Analytics with Hadoop 3”, Packt Publishing Ltd, 2018
2. Gates, Alan, and Daniel Dai. *Programming pig: Dataflow scripting with hadoop*. " O'Reilly Media, Inc.", 2016.
3. Capriolo, Edward, Dean Wampler, and Jason Rutherglen. *Programming Hive: Data warehouse and query language for Hadoop*. " O'Reilly Media, Inc.", 2012.

REFERENCE BOOKS:

1. Michael Minelli, Michele chambers, AmbigaDhiraj,”Big data, big analytics”, Wiley,2013
2. P. Tan, M. Steinbach, V. Kumar, “Introduction to Data Mining”, Addison-Wesley, 2005.
3. J. Han, M. Kamber, “Data Mining: Concepts and Techniques”, 2nd ed. Morgan Kaufmann 2005.

JOURNALS/MAGAZINES

1. IEEE,Introduction to the IEEE Transactions on Big Data.

2. Elsevier,Big data research journal Elsevier.
3. Springer, Journal on Big Data Springer.

Course Title	**Mobile Application Development Lab**				**CourseType**		**HC**	
Course Code	M22TC0208	**Credits**	**1**		**Lab**		**II Semester**	
Course Structure	TLP	Credits	Contact Hou	WorkLo	Total Number of Classes Per Semester		Assessment in Weighta	
	Theory	-	-	-				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**1**	**2**	**2**	**-**	**26**	**25**	**25**

COURSE OVERVIEW:

The Android Laboratory is a 28-hours module within the Course on Mobile Application Laboratory, for the undergraduate students of REVA University. The goal of this module is to introduce the basics of mobile applications development for Android-based terminals. We aim at presenting the essential concepts of APP development and deployments for mobile and battery-constrained devices, at introducing the main characteristics and components of the Android projects, and at providing the minimum know-how required to develop(from scratch) mobile applications for the Android architecture, at increasing levels of complexity.

COURSE OBJECTIVE (S):

1. Creating robust mobile applications and learn how to integrate them with other services.
2. Creating intuitive, reliable mobile apps using the android services and components.
3. Demonstrate the use of knowledge of Android Studio development tool.
4. Creating intuitive, reliable mobile apps using the android services and components.

COURSE OUTCOMES (COs)

After the completion of the course, the student will bea ble to:

CO#	CourseOutcomes	POs	PSOs
CO1	Build enterprise level mobile applications with Android	1 to 6,9,11,12	1,2,3
CO2	Understand both the basic and advanced concepts of Android.	1 to 6,9,11,12	1,2,3
CO3	Understand why use Android over Java.	1 to 6,9,11,12	1,2,3
CO4	Install and configure Android Studio.	1 to 6,9,11,12	1,2,3
CO5	Explain and use key Android programming concepts.	1 to 6,9,11,12	1,2,3
CO6	Deploy the App application in different devices.	1 to 6,9,11,12	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		√				
CO2			√			
CO3					√	
CO4			√			
CO5					√	

CO6			√			

COURSE ARTICULATIONMATRIX

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	3	3	3
CO2	3	3	3	3	3	3			3		3	3	3	3
CO3	3	2	3	3	3	3			3		3	3	3	3
CO4	3	3	3	3	3	3			3		3	3	3	3
CO5	3	3	3	3	3	3			3		3	3	3	3
CO6	3	2	3	3	3	3			3		3	3	3	3

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

PRACTICE:

Programs	Problem statements	Tools and Techniques	Expected Skill/Ability
1	Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the centre. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.	Windows/Linux OS, android studio	J2SE Android and XML concept
2	Develop an Android application using controls like Button, TextView, Edit Text for designing a calculator having basic functionality like Addition, Subtraction, Multiplication, and Division.	Windows/Linux OS, android studio	J2SE Android and XML concept

3	Create an android application to implement the spinner class using java	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
4	Create an android application to Demonstrate the check box and radio button	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
5	Create an android application to demonstrate Scroll View	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
6	Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules: a. Password should contain uppercase and lowercase letters. b. Password should contain letters and numbers. c. Password should contain special characters. d. Minimum length of the password (the default value is 8). On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying “Successful Login” or else display a toast message saying “Login Failed”. The user is given only two attempts and after that display a toast message saying “Failed Login Attempts” and disable the SIGN IN button. Use Bundle to transfer information from one activity to	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**

	another.		
7	Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
8	Write a program to create an activity with two buttons START and STOP. On pressing of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a TextView control	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
9	Create two files of XML and JSON type with values for City_Name, Latitude, Longitude, Temperature, and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t, JSON**
10	Develop a simple application with one Edit Text so that the user can write some text in it. Create a button called “Convert Text to Speech” that converts the user input text into voice.	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**

11	Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t**
12	Create an android application to perform crud operation using SQL_Lite database	Windows/Linux OS, android s**t**udio	J2SE Android and XML concep**t and sql concepts**

Text Books:

1. Head First Android Development, 3rd Edition [Book], by Dawn Griffiths, David Griffiths Released November 2021Publisher(s): O'Reilly Media, Inc.ISBN: 9781492076476.

2. Professional Android, 4th EditionReto Meier, Ian LakeISBN: 978-1-118-94952-8 December 2018.

3. Android for Absolute Beginners: Getting Started with Mobile Apps Development Using the Android Java SDK Paperback – Import, 29 May 2021

Reference Books:

1.**Android Programming for Beginners**, John Horton 2nd edition, Packt Publishing.
2. Android App Development FD, Michael Burton,3rd edition

JOURNALS/MAGAZINE:

1. https://ieeexplore.ieee.org/document/6104696

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106106156

2. https://onlinecourses.nptel.ac.in/noc20_cs52/preview

3. https://www.coursera.org/learn/aadcapstone

4. https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

SELF-LEARNING EXERCISES:

1. Android Development

Course Title	Mini Project				Course Type	Practice	
Course Code	M22TC0209	Credits	2		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semeste	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	0	-	-			
	Total	**2**	**4**	**4**	**56**	**25**	**25**

COURSE OVERVIEW:

The research based mini project is focused at providing the platform for students to enhance their research aptitude and develop the skills they require for developing the trending applications using the latest technologies. Additionally, this course gives a platform to students to showcase their talent by doing innovative projects that strengthen their profile making themselves employable in various domains.

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 will be allotted guides based on their area of interest.
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 (review-1 presentation (progress)), and review-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 Title	Tree Plantation in Tropical Region: Benefits and Strategic Planning				Course Type	Theory	
Course Code	M22AS0201	Credits	1		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	1	1	1			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	**1**	**1**	**1**	**14**	**50%**	**50%**

COURSE DESCRIPTION:

This course introduces significance of trees that provide us with a great many ecosystem services, including air quality improvement, energy conservation, stormwater interception, and atmospheric carbon dioxide reduction. These benefits must be weighed against the costs of maintaining trees, including planting, pruning, irrigation, administration, pest control, liability, cleanup, and removal.

Students are expected to involve in planting a tree and nurturing till the completion of their degree program. Successful maintenance of tree is considered to be one of the eligibility criterions for the award of university degree.

COURSE OBJECTIVE (S):

The Course objectives are to

1. Develop basic understanding of role of trees in climate change

2. Emphasize on the selection and placing a tree for maximum benefit to environment

3. Involve in planting a tree and nurture till the completion of the degree program

4. Generate experiential report on the tree plantation process involved

COURSE OUTCOMES:

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Interpret the possible key benefits of trees arresting climate change and global warming	7	-
CO2	Develop the ability to identify the type of a tree to be planted in urban areas, agricultural fields and forestry areas	7	-
CO3	Make use of reading different literature on climate change and global warming by adopting various reading strategies (Reading Skills)	7	-
CO4	Take part in planting a tree and nurturing it	7	-

BLOOM'S LEVEL OF THE COURSE OUTCOMES

CO#	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1		✓		✓		
CO2		✓	✓	✓		
CO3		✓		✓		
CO4		✓		✓		✓

COURSE ARTICULATION MATRIX

CO#/ Pos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO1							3								
CO2							3								
CO3							3								
CO4							3								

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

COURSE CONTENT

Unit 1: Introduction: The tropical region, Benefits and costs of urban and community forests

Unit 2: General Guidelines for Selecting and Placing Trees Guidelines for Energy Savings, Guidelines for Reducing Carb Dioxide, Guidelines for Reducing Stormwater Runoff, Guidelines for Improving Air Quality Benefits, Guidelines Avoiding Conflicts with Infrastructure, Guidelines for Maximizing Long-Term Benefits, Trees for Hurricane-Prone Areas

Activity based learning Every student has to thoroughly understand the significance of planting a tree, identify type tree and place to be planted, plant a tree and nurture till the completion of the degree.

Text Books:

1. Kelaine E. Vargas, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Shelley L. Gardner, and Qingfu Xiao, "Tropical community tree guide: Benefits, Costs and Strategic Planting", U.S. Department of Agriculture, Forest Service Pacific Southwest Research Station Albany, California, 2008

Reference Books:

1. Peter Wohlleben, The Heartbeat of Trees, Penguin Books, 2021
2. Daniel Chamovitz, "What a Plant Knows: A Field Guide to the Senses", 2020

II Year

Detailed Syllabus

III Semester
Syllabus

Course Title	Multicore Architecture and Programming				Course Type	Theory	
Course Code	M22TCS311	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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

This course gives a glance into introduction to multi core architecture and programming a multi core system. It gives a brief insight into the different parallel programming environment variables and problem like dead lock, live lock etc. The subject also deals with parallel programming concepts and multi threaded programming to make a output much better using open MP and MPI.

COURSE OBJECTIVES:

1. To understand the need for multi-core processors, and their architecture.
2. To understand the challenges in parallel and multi-threaded programming.
3. To learn about the various parallel programming paradigms.

4. To develop multicore programs and design parallel solutions.

COURSE OUTCOMES:

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Describe multicore architectures and identify their characteristics and challenges.	1 to 5	1,2,3
CO2	Identify the issues in programming Parallel Processors.	1 to 5	1,2,3
CO3	Write programs using OpenMP and MPI.	1 to 5	1,2,3
CO4	Design parallel programming solutions to common problems.	1 to 5	1,2,3
CO5	Compare and contrast programming for serial processors and programming for parallel processors.	1 to 5	1,2,3
CO6	Understand MPI derived datatype and its performance evaluation.	1 to 5	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		√				

COURSE ARTICULATION MATRIX

CO#	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	3	3
CO4	3	3	3	2	2							3	3	3
CO5	3	2	3	2	1							3	3	3
CO6	3	3	2	3	2							3	3	3

COURSE CONTENT

UNIT-1

MULTI-CORE PROCESSORS: Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design.

UNIT-2

PARALLEL PROGRAM CHALLENGES : Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT-3

SHARED MEMORY PROGRAMMING WITH OpenMP : OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

UNIT-4

DISTRIBUTED MEMORY PROGRAMMING WITH MPI: program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

Self Learning Modules

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TEXT BOOKS:

1. Peter S. Pacheco, “An Introduction to Parallel Programming‖”, Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris‖”, Pearson, 2011 (unit 2)

REFERENCE BOOKS

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP‖", Tata McGraw Hill,2003.
2. Victor Alessandrini, "Shared Memory Application Programming", 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
3. Yan Solihin," Fundamentals of Parallel Multicore Architecture", CRC Press, 2015.

JOURNALS/MAGAZINES

1. IEEE Transactions on Parallel and Distributed Systems
2. Springer International Journal of Parallel Programming
3. Elsevier Journal of Parallel and Distributed Computing

SWAYAM/NPTEL/MOOCS:

https://onlinecourses.nptel.ac.in/noc22_cs110/preview

<table>
<tr><td>Course Title</td><td colspan="4">Computer Vision</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M22TCS312</td><td>Credits</td><td colspan="2">3</td><td>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 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>-</td><td>-</td><td>-</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>42</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 Applications range from biometrics, medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering.

COURSE OBJECTIVE (S):

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 (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Utilize linear filters and mathematical modeling methods for low-, intermediate- and high- level image processing tasks to enhance the quality of images.	1 to 5	1,2,3
CO2	Develop Segmentation technique to solve real world problems.	1 to 5	1,2,3
CO3	Design and Develop program for registration and classification of images.	1 to 5	1,2,3
CO4	Apply object detection and recognition techniques to solve real world problems.	1 to 5	1,2,3
CO5	Make use of algorithms to build a complete system to solve a computer vision problem.	1 to 5	1,2,3
CO6	Identify the software experiments on computer vision problems and compare their performance with the state of the art.	1 to 5	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			√			

COURSE ARTICULATION MATRIX

CO#/ POs	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	2							3	3	2
CO5	3	3	3	3	1							3	3	3
CO6	3	3	3	3	2							3	3	3

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

COURSE CONTENT

UNIT – 1

Introduction and overview to computer vision: 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

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.

TEXT BOOKS:

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

2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011

3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004

REFERENCE BOOKS:

1. David Marr, Tomaso A. Poggio, Shimon Ullman "A Computational Investigation into the Human Representation and Processing of Visual Information", MIT Press Scholarship Online: August 2013 eBook - Amazon.com
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

JOURNALS/MAGAZINES:

1. Springer Journal on Computer Vision
2. Springer Journal on Computer Vision
3. Elsevier Journal on Computer Vision
4. International Journal of Computer Vision, Springer

SWAYAM/NPTEL/MOOCS:

1. https://www.classcentral.com/course/ Computer Vision
2. https://onlinecourses.nptel.ac.in/ Computer Vision
3. https://nptel.ac.in/courses/443/766/2346106156/
4. Computer Vision and Image Processing - Fundamentals and Applications: https://onlinecourses.nptel.ac.in/noc21_ee23/preview

SELF-LEARNING EXERCISES:

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

Course Title	**Advance Information Security**				**Course Type**	Theory	
Course Code	M22TCS313	**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	-	-	-	Theory	CIE	SEE
	-	0	-	-			
	Total	**3**	**3**	**3**	**42**	**50**	**50**

COURSE OVERVIEW:

Basic information security goals of availability, integrity, accuracy, and confidentiality. Identification of exposures and vulnerabilities and appropriate countermeasures are addressed. The importance of appropriate planning and administrative controls is also discussed. Additional topics include: instruction in security for network hardware, software, and data including physical security, backup procedures, firewalls, encryption, and protection from viruses. Computer security; Need of Security; Access Control; Security policies; Software vulnerabilities; Secure Electronic transactions; Secure socket layer; transport layer security; Privacy.

COURSE OBJECTIVE (S):

1. To introduce the concepts of Information Security
2. To understand the various encryption algorithms
3. Students will be focus on the models, tools, and techniques for enforcement of security.
4. Students will learn security from multiple perspectives.

COURSE OUTCOMES (COs)

After the completion of the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the security requirements like confidentiality, integrity, and availability to secure network assets from threats and attacks.	1 to 5	1,2,3
CO2	Analyze virus, malicious software and worms for detecting distributed Daniel of service attacks	1 to 5	1,2,3
CO3	Apply handshaking, alert and change cipher spec protocols and Coding function to secure SSL and TL	1 to 5	1,2,3
CO4	Apply PGP model and canonical forms to secure E-Mail data at transport layer.	1 to 5	1,2,3
CO5	Design firewall to secure the system by applying various intrusion detection systems.	1 to 5	1,2,3
CO6	Apply privacy techniques to protect information in the network.	1 to 5	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		√	√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	3	2							3	3	2
CO2	3	3	2	2	2							3	3	2
CO3	3	3	3	3	3							3	3	2
CO4	3	3	3	3	2							3	3	2
CO5	3	3	3	3	3							3	3	2
CO6	3	3	3	3	3							3	3	2

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

THEORY:

UNIT I

INTRODUCTION: Computer Security Concepts, the OSI Security Architecture, Security Attacks, Security Mechanism, Standards.

Malicious Software: Types of Malicious Software, Viruses, Worms, Distributed Denial of Service Attacks.

UNIT II

SECURITY AT TRANSPORT LAYER: SSL & TLS: Web Security Consideration, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell.

Wireless Network Security: IEEE 802.11 Wireless LAN Overview, IEEE 802.11i LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP end-to-end Security

UNIT III

SECURITY AT APPLICATION LAYER: PGP AND S/MIME: Pretty Good Privacy, S/MIME, Domain keys Identified Mail

IP Security: IP Security Overview, IP Security Policy, IP Security Architecture, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

UNIT IV

INTRUDERS Intruders, Intrusion Detection, and Password Management.

Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall location and configuration.

Privacy: Evade Traffic analysis, Tunnel SSH through Tor, Encrypt you file seamlessly, Guard against Phishing, Use the web with fewer passwords, Encrypt your E-mail with Thunderbird, Encrypt you E-mail in Mac OS X

AND FIREWALLS: **Intrusion Detection System:**

TEXT BOOKS:

1. William Stallings "Network Security Essentials (Applications and Standards)", 4th Edition, Pearson Education 2011.
2. Andrew Lockhart "Information security Hacks (Tips and Tools for protecting your privacy)", 2nd Edition, 2004.

REFERENCE BOOKS:

1. Behrousz A Forouzan, D Mukhopadhyay, "Cryptography and network Security", 1st Edition, McGraw Hill.
2. CharlieKaufman, Radia Perlman and Mike Speciner, Network Security – Private Communication in a Public World, 2nd Edition, Pearson/PHI.

JOURNALS / MAGAZINES:

1. http://www.inf.ufsc.br/~bosco.sobral/ensino/ine5680/material-cripto-seg/2014 1/Stallings/Stallings_Cryptography_and_Network_Security.pdf.
2. http://www.ijcsmc.com/docs/papers/January2015/V4I1201544.pdf.
3. https://dl.acm.org/doi/abs/10.1145/356789.356793
4. https://www.sciencedirect.com/science/article/pii/S2214212622000370

SWAYAM / NPTEL / MOOCs

1. http://nptel.ac.in/syllabus/106105031/.
2. https://www.udemy.com/course/practical-information-security/
3. https://www.coursera.org/learn/information-systems-audit

SELF-LEARNING EXERCISE:

1. Design and implementation of a network
2. Manage security in small business network application
3. Application of S/MIME, PGP in e-mail security

Course Title	Project Work Phase-1				Course Type	Practice	
Course Code	M22TC0302	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	4	8	8		CIE	SEE

	-	0	-	-	Practice		
	Total	**4**	**8**	**8**	**112**	**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, understand the impact of project results in the context of environmental sustainability.	6	1,2,3
CO7	Function effectively as individual and a member in the project team. Demonstrate knowledge and understanding of cost and time analysis required for carry out the project.	7	1,2,3

CO8	Develop communication skills, both oral and written for preparing and presenting project report.	8	1,2,3
CO9	Engage in lifelong learning to improve knowledge and competence in the chosen area of the project.	9	1,2,3
CO10	Understand professional and ethical responsibilities while executing the project work.	10	1,2,3
CO11	Demonstrate knowledge and understands the mistakes from the project through self-learning.	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 III 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 has to 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	Internship				Course Type	Practice	
Course Code	M22TC0303	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	4	8	8	Practice	CIE	SEE
	-	0	-	-			
	Total	**4**	**8**	**8**	**112**	**50**	**50**

COURSE OVERVIEW

An internship can present students with new skills and opportunities. Interns not only gain technical knowledge within the industry of their choice, but they also learn how to interact with professionals in a workplace setting, and develop essential soft skills like time management, organization, adaptability, problem-solving and teamwork.

COURSE OBJECTIVE (S):

1. To allow students to develop problem solving, analysis, synthesis and evaluation skills.
2. To encourage teamwork.
3. To help students to gain exposure into industries.
4. 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	PO12	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 Internship:

- The internship should be paid internship in IT industry.
- The internship should be for minimum of three months.
- The project title must be submitted in form a document (synopsis) that contains the proposed title of the project, an abstract, Introduction and their roles and responsibilities in company.
- Each student shall be reviewed and evaluated in two reviews through the semester.
- Review 1 shall be on the presentation of the synopsis.
- Review 2 shall be on the presentation on the roles and responsibilities carried out with module competion results(as applicable).

Course Title	Global Certification				Course Type	Practice	
Course Code	M22TC0303	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semeste	Assessment in Weightage	
	Theory	0	0	0			
	Practice	4	8	8	Practice	CIE	SEE
	-	0	-	-			
	Total	**4**	**8**	**8**	**112**	**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.

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	PO12	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 Global certification 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.

<table>
<tr><td>Course Title</td><td colspan="4">Open Elective</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M22TCO301</td><td>Credits</td><td colspan="2">4</td><td>Class</td><td colspan="2">III 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 ClassesPer Semeste</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>4</td><td>4</td><td>4</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>4</td><td>4</td><td>4</td><td>56</td><td>50</td><td>50</td></tr>
</table>

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.

Student should enroll for Nptel course from non computer science and engineering/multidisciplinary stream.

IV Semester
Syllabus

Course Title	Project Work Phase – 2 and Dissertation				Course Type	Practice	
Course Code	M22TC0401	Credits	12		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	12	24	24	Practice	CIE	SEE
	-	0	-	-	Practical		
	Total	12	24	24	**168**	**50**	**50**

COURSE OVERVIEW

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

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	PO12	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.