REVA UNIVERSITY
Bengaluru, India

School of Computing and Information Technology

B.Tech. CSSE

2020-24 Batch

HANDBOOK

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

SCHOOL OF COMPUTING AND INFORMATION TECHNOLOGY

HANDBOOK

B. Tech in CSSE (Computer Science and Systems Engineering)

(2020-24)

Rukmini Knowledge Park,
Kattigenahalli, Yelahanka, Bangalore - 560 064
Phone No: +91-080-46966966

Rukmini Educational
Charitable Trust

www.reva.edu.in

Chancellor's Message

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

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

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

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

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

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

Dr. P. Shyama Raju
The Founder and Honourable Chancellor, REVA University

Vice-Chancellor Message

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

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

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

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

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

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

Welcome to the portals of REVA University!

Dr.M.Dhanamjaya

Vice-Chancellor, REVA University

Director Message

I congratulate and welcome all the students to the esteemed School of Computing and Information Technology (C & IT)). You are in the right campus to become a computer technocrat. The rising needs of automation in Industry 4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of computers and IT. The B.Tech, M.Tech and Ph.D programs offered in the school are designed to cater the requirements of industry and society. The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, AMD, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc).

This handbook presents the B.Tech in Information Science and Engineering program curriculum. The program is of 4 years duration and split into 8 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of ISE. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, Information Theory, Information Security, Information Communication and Information Systems. Theoretical foundations of engineering, science, and Information Science are taught in first two and half years. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization. The Curriculum caters to local, national, regional and global developmental needs. Maximum number of courses are integrated with cross cutting issues relevant to professional ethics, global needs, human values, environment and sustainability. The curriculum also focusses on skill development, innovation and entrepreneurship.

The important features of the B.Tech ISE are as follows:

1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, NLP, IoT and Cloud security, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft skills training and 10) Platform for exhibiting skills in cultural, sports and technical activities through clubs and societies. The school has well qualified faculty members in the various areas of computing and IT including cloud computing, security, IOT, AI, ML and DL, software engineering, computer networks, information technology, cognitive computing, block chain technology etc. State of art laboratories are available for the purpose of academics and research.

Dr. Mallikarjun Kodabagi

Director, School of Computing, and Information Technology

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RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 15,000+ 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 dated 7th February, 2013. The University is recognised by UGC under Sec 2 (f) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. The Programs of the University are approved by All India Council for Technical Education (AICTE), University Grants Commission (UGC), Bar Council of India (BCI), and Council of Architecture (COA) .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, auditoriums, seminar halls ,custom-built teaching facilities, fully air-conditioned library and central computer centre, well-planned sports facility with cricket ground, running track & variety of indoor and outdoor sports activities, facilities for cultural programs. The unique feature of REVA campus is the largest residential facility for students, faculty members and supportive staff.

The University is presently offering 26 Post Graduate Degree programs, 35 Undergraduate programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 494 Scholars pursuing research leading to PhD in 19 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis on 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 importance 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, Big data analytics, Information Retrieval,VLSIand Embedded Systems, Wireless Sensor Networks, Artificial Intelligence, 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 Lighting, Renewable Energy Sources and Active Filter, Innovative Concrete Reinforcement, Electro Chemical Synthesis, Energy Conversion Devices, Nano-structural Materials, Photo-electrochemical Hydrogen generation, Pesticide Residue Analysis, Nano materials, Photonics, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop 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 and Dean, and supported by well experienced Trainers, Counsellors and Placement Officers. The University also has University-Industry Interaction (UIIC) and Skill Development Centre headed by a Senior Professor and Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs, Entrepreneurship activities, and IPR workshops. UIIC has established REVA NEST, an incubation centre for promoting start up industries.

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, University of California Berkeley, Arkansas State University, Columbia University, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between students and successful industrialists, entrepreneurs, scientists and such others from time to time. As a part of this exercise great personalities such as Bharat RatnaProf. 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 I.I.Sc., and noted Scientist, Dr. V S Ramamurthy,

Former Secretary, DST, Government of India, Dr. V K Aatre, noted Scientist and former head of the DRDO and Scientific Advisor to the Ministry of Defence Dr. Sathish Reddy, Scientific Advisor, Ministry of Defence, New Delhi and many others have accepted our invitation and blessed our students and faculty members by their inspiring addresses and interaction.

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such award instituted by REVA University is **'Life Time Achievement Award'** to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the **"Founders' Day Celebration"** of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "**REVA Life Time Achievement Award**" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "**REVA Award of Excellence"** in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes 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 REVOTHASAVA 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 ShubhaVidaaya, - 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 recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Within short span of time, REVA University has been recognised as a fast growing university imparting quality higher education to the youth of the country and received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include: Asia's Greatest Brand and Leaders, by Asia One, National Award of Leadership Excellence, by ASSOCHAM India, Most promising University, by EPSI, Promising Upcoming Private University in the Country, by The Economic Times, Best University of India (South), by Dialogue India, Gold Brand by QS University Ranking, placed under 151-200 band by NIRF, 6TH Rank in the Super Excellence category by GHRDC, 6TH Rank in All India Law School Survey, ranked among Top 30 Best B Schools by Business World, India's Best Law Institution by Careers 360, to mention a few.

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 COMPUTING AND INFORMATION TECHNOLOGY

The school has a rich blend of experienced and committed faculty who are well-qualified in various aspects of computing and information technology apart from the numerous state-of-the-art digital classrooms and laboratories having modern computing equipment. The School offers four full-time undergraduate programs, B.Tech in Computer Science and Engineering (Artificial Intelligence and Machine Learning), B.Tech in Computer Science and Information Technology, B.Tech in Computer Science and Systems Engineering, B.Tech in Information Science and Engineering and the following two postgraduate programs: M.Tech in Artificial Intelligence and M.Tech in Cyber security. In addition, the school has a research centre in which students can conduct cutting edge research leading to a Ph.D degree.

Curriculum 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 programs 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 Artificial Intelligence and Information Technology 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.

School Vision

To produce excellent quality technologists and researchers of global standards in computing and Information technology who have potential to contribute to the development of the nation and the society with their expertise, skills, innovative problem-solving abilities, strong moral and ethical values.

School Mission

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

Quality Policy

The school of computing and Information Technology 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 exhibition, Internship and Entrepreneurship 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		Correspondence Address
1	**Dr. Mallikarjun M Kodabagi** Professor and Director School of Computing and Information Technology REVA University	Chairperson	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
2.	**Dr. Vishwanath R Hulipalled** Professor School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
3.	**Dr. Udaya Rani V** Professor School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
4.	**Dr. Parthasarathy G** Associate Professor, School of C&IT	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
5.	**Dr. Karthik S A** Assistant Professor, School of Computing and Information Technology	Member	Rukmini Knowledge Park, Kattigenahalli, Yelahanka, Bengaluru, Karnataka 560064
6.	**Sreenivasa Ramanujam Kanduri** Academic Relationship Manager, TCS	Member (Industry Expert)	Academic Relationship Manager, Tata Consultancy Services, Bangalore.
7.	**Dr. Sundar K S** Associate Vice-President & Head, IMS Academy at Infosys	Member (Industry Expert)	Associate Vice-President & Head, IMS Academy at Infosys, Mysore
8.	**Dr. Ramabrahmam Gunturi** Consultant, TCS	Industry Expert	Tata Consultancy Services, Hyderabad.
9.	**Dr. S. A. Angadi** Professor, School of CSE,VTU	Academic Expert	Professor, School of CSE Visvesvaraya, Belagavi
10.	**Dr. BharatiArakeri** Professor**,** School of CSE BMSIT, Bangalore.	Academic Expert	Professor**,** School of CSE BMSIT, Bangalore
11.	**AbhishekRevannaSwamy** Associate Project Manager, Robert Bosch	Alumni-Member	Associate Project Manager, Robert Bosch, Bangalore
12.	**Prasad Chitta** Solution Architect, TCS Bangalore	Member (Industry Expert)	Solution Architect, TCS, Bangalore

B. Tech Computer Science and System Engineering

Program Overview

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

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

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

The career opportunities for Computer Science and System Engineering graduates are plenty and growing. Programming and software development, information systems operation and management,data science, information retrieval, big data analytics, telecommunications and networking, Machine Learning development, computer science research, web and Internet, graphics and multimedia, training and support, and computer industry specialists are some of the opportunities the graduates find.

The School of Computing and Information Technology at REVA UNIVERSITY offers B. Tech., Computer Science

and System Engineering programme to create motivated, innovative, creative thinking graduates to fill ICT positions across sectors who can conceptualize, design, analyze, and develop ICT applications to meet the modern day requirements.

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

This program involves various courses which are related to computation, like design and analysis of algorithms, computer programming languages, software design, Information Theory, IoT and Smart Sensors, Agile Software Engineering and DevOps, Big Data and Hadoop, Python for Data Analysis, Machine Learning and Information Science, Cloud Computing, Computer Vision, Business Intelligence, Information Retrieval, Management Information Systems, AI and Agents, Fuzzy Logic and Systems, Data Analytics Using "R", Multi Media Systems, Introduction to Drones. Block Chain Technology, Swarm Intelligence, Software Defined Networks and NFV, Natural Language Processing, Augmented and Virtual Reality, Robotic Process Automation, Deep Learning and Reinforcement Learning, UI/UX Design, Cyber Forensics. This program also has courses such as electrical and electronics engineering, applied sciences and linguistics. This specialization is proposed to enable students to design software to solve problems in industry and engineering that require computers.

Program Educational Objectives (PEO's)

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

- **PEO-1:** Communicate as a member in team and develop code to solve problems in software industry.
- **PEO-2:** Start enterprise to improve the economy of the country for providing the support to the customer for lifelong learning attitude.
- **PEO-3:** Pursue higher education in the field of Information Science and Engineering in allied areas.

Program Outcomes(PO's)

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

- **PO-1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals for the solution of complex problems in Computer Science and Engineering.

- **PO-2: Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
- **PO-3: Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO-4: Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO-5: Modern tool usage:** Create, select, 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: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO-8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- **PO-9: Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
- **PO-10: Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
- **PO-11: Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
- **PO-12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

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

- **PSO-1**: Develop and write algorithms in Information Science and Engineering
- **PSO-2**: Analyze and Solve problems in the field of Information Science and Engineering and address the real life situations in the industry.
- **PSO-3**: Use different tools and techniques in Information Science and Engineering and allied areas.

REVA University Academic Regulations

B. Tech Degree Programs

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

Title and Commencement:

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

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

The Programs:

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

B. Tech in:

Bioelectronics Engineering
Civil Engineering
Computer Science and Engineering
Computer Science and Information Technology
Computer Science and Systems Engineering
Computer Science and Engineering (AI and ML)
Electrical and Electronics Engineering
Electrical and Computer Engineering
Electronics and Communication Engineering
Electronics and Computer Engineering
Information Science and Engineering
Mechanical Engineering
Mechatronics Engineering

Duration and Medium of Instructions:

Duration: The duration of the B. Tech degree program shall be FOUR years comprising of EIGHT Semesters. A candidate can avail a maximum of 16 semesters - 8 years as per double duration norm, in one stretch to complete B. Tech degree, including blank semesters, if any. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

The medium of instruction shall be English.

Definitions:

Course: “Course” means a subject, either theory or practical or both, listed under a program; Example: “Fluid Mechanics” in B. Tech Civil Engineering program, Engineering Thermodynamics in B. Tech., Mechanical program are examples of courses to be studied under respective programs.

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

L	Lecture
T	Tutorial
P	Practice

Where:

L stands for Lecture session consisting of classroom instruction.

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

P stands for Practice session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

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

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

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

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.

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.

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.

Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problems to solve a multivariable or complex engineering problems. The project will be conducted in two phases, Phase-I (7th Semester), consists of literature survey, problem identification, formulation and methodology. In Phase-II (8th Semester) student should complete the projectwork by designing or creating aninnovative process or development of product as an outcome. A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of SIX, EIGHT, or TEN, credits is called Major Project work / Dissertation. A Minor Project work may be a hard core or a Soft Core as decided by the BOS / concerned. But the Major Project shall be Hard Core.

"Program" means the academic program leading to a Degree, Post Graduate Degree, Post Graduate Diploma Degree or such other degrees instituted and introduced in REVA University.

Eligibility for Admission:

5.1. The eligibility criteria for admission to B. Tech Program of 4 years (8 Semesters) is given below:

Sl. No.	Program	Duration	Eligibility
1	Bachelor of Technology (B. Tech)	4 Years (8 Semesters)	Passed 10+2 examination with Physics and Mathematics as compulsory subjects, along with any one of the following subjects, namely, Chemistry, Bio-Technology, Computer Science, Biology, Electronics and Technical Vocational subject Obtained at least 45% marks (40% in case of candidate belonging to SC/ST category) in the above subjects taken together.
2	Bachelor of Technology (B. Tech)	Lateral entry to second year	(A) Passed Diploma examination from an AICTE approved Institution with at least 45% marks (40% in case of candidates belonging to SC/ST category) in appropriate branch of Engineering / Technology. (B) Passed B. Sc Degree from a recognized University as defined by UGC, with at least 45% marks (40% in case of candidates belonging to SC/ST category) and passed XII standard with mathematics as a subject. (C) Provided that in case of students belonging to B. Sc. Stream, shall clear the subjects of Engineering Graphics / Engineering Drawing and Engineering Mechanics of the first year Engineering program along with the second year subjects.

			(D) Provided further that, the students belonging to B. Sc. Stream shall be considered only after filling the seats in this category with students belonging to the Diploma stream. (E) Provided further that student, who have passed Diploma in Engineering & Technology from an AICTE approved Institution or B. Sc., Degree from a recognized University as defined by UGC, shall also be eligible for admission to the first year Engineering Degree courses subject to vacancies in the first year class in case the vacancies at lateral entry are exhausted. However, the admissions shall be based strictly on the eligibility criteria as mentioned in A, B, D, and E above.
3	Bachelor of Technology (B. Tech)	Lateral entry to fourth year (final year)	(F) Any candidate with genuine reason from any University / Institution in the country upon credit transfer could be considered for lateral admission to the respective semester in the concerned branch of study, provided he/she fulfils the University requirements.
5	B. Tech. in Bioelectronics		Pass in PUC /10+2 examination with Physics, Biology/Biotechnology as compulsory along with at least one of the Chemistry/Mathematics / Computer Science / Electronics obtained minimum 45% marks (40% in case of candidates belonging to SC / ST category) in the above subjects taken together of any board recognized by the respective State Government / Central Government / Union Territories or any other qualification recognized as equivalent there to.

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

Courses of Study and Credits

Each course of study is assigned with certain credit value

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

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.

Credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

The following table describes credit pattern

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

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

Different Courses of Study:
Different Courses of Study are labeled as follows:
Core Course (CC)
Foundation Course (FC)
Hard Core Course (HC)
Soft Core Course (SC)
Open Elective Course (OE)
Project Work / Dissertation:

A project work carrying TWO, FOUR or SIX credits is called Minor Project work / Dissertation. A project work of EIGHT, TEN, TWELVE or SIXTEEN credits is called Major Project work / Dissertation. A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.

These are defined under Section 4 of these regulations.

Credits and Credit Distribution

A candidate has to earn 160 credits for successful completion of B. Tech degree with the distribution of credits for different courses as given in table below:

Course Type	Credits (Range)
	For B. Tech Degree (8 Semesters)
Foundation Core Course	A minimum of 06 but not exceeding 12
Hard Core Course	A minimum of 118 but not exceeding 121
Soft Core Course	A minimum of 15 but not exceeding 21
Open Elective	A minimum of 04 but not exceeding 12

8.2. The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as Foundation Course (FC), Hard Core (HC) or Soft Core (SC), Open Elective (OE).

8.3. Every course including project work, practical work, field work, self-study elective should be entitled as Foundation Course (FC), Hard Core (HC) or Soft Core (SC) or Open Elective (OE) or Core Course (CC) by the BoS concerned. However, following shall be the Foundation Courses with credits mentioned against them, common to all branches of study.

Sl. No.	Course Title	Number of Credits
Foundation Courses		
1	English for Technical Communication / Communication Skills	2
2	Environmental Studies / Environmental Science	2
3	Indian Constitution and Professional Ethics	2
4	MOOC / Internship /Soft Skill Training	6-15

8.4. The concerned BOS shall specify the desired Program Educational Objectives, Program Outcomes, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

8.5. A candidate can enrol for a maximum of 28 credits and a minimum of 19 credits per Semester. However he / she may not successfully earn a maximum of 28 credits per semester. This maximum of 28 credits does not include the credits of courses carried forward by a candidate.

Only such full time candidates who register for a minimum prescribed number of credits in each semester from I semester to VIII semester and complete successfully 160 credits in 8 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.

Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B. Tech Degree program.

Add on Proficiency Diploma / Minor degree/ Honor Degree:

To acquire Add on Proficiency Diploma/ Minor degree/ Honor Degree:, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 160 credits for the B. Tech Degree program.

The Add on Proficiency Certification / Diploma/ Minor degree/ Honor Degree: so issued to the candidate contains the courses studied and grades earned.

Assessment and Evaluation

The Scheme of Assessment will have two parts, namely;

Internal Assessment (IA); and

Semester End Examination (SEE)

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

The 50 marks of internal assessment shall comprise of:

Internal Test	30 marks
Assignments / Seminars / Model Making / Integrated Lab / Project Based Learning / Quizzes etc.	20 marks

There shall be two Internal Tests conducted as per the schedule announced below. The students shall attend both the Tests compulsorily.

1st test is conducted for 15 marks during 6th week of the semester;

2nd test is conducted for 15 marks during 12th week of the of the semester;

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

Question paper of the 1st test should be based on first 40 %of the total syllabus;

Question paper of the 2nd test should be based on second 40 %of the total syllabus;

An assignment must be designed to cover the last 20% of the syllabus

There shall be one Assignment / Project Based Learning / Field Visit / Quiz test carrying 20 marks covering the last 20% of the Syllabus

The Semester End Examination for 50 marks shall be held in the 18th and 19th week of the beginning of the semester and the syllabus for the semester end examination shall be entire syllabus.

A test paper is set for a maximum of 30 marks to be answered in 1 hour duration. A test paper can have 4 main questions. Each main question is set for 10 marks. The main question can have 2-3 sub questions all totalling 10 marks. Students are required to answer any three main questions. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document.

The question papers for internal test shall be set by the internal teachers who have taught the course. If the course is taught by more than one teacher all the teachers together shall devise a common question paper(s). However, these question papers shall be scrutinized by the Question Paper Scrutiny Committee to bring in the uniformity in the question paper pattern and as well to maintain the necessary standards.

The evaluation of the answer scripts shall be done by the internal teachers who have taught the course and set the test paper.

Assignment/seminar/Project based learning/simulation based problem solving/field work should be set in such a way, students be able to apply the concepts learnt to a real life situation and students should be able to do some amount self-study and creative thinking. While setting assignment care should be taken such that the students will not be able to plagiarise the answer from web or any other resources. An assignment / Quiz can be set for a maximum of 20. Course instructor at his/her discretion can design the questions as a small group exercise or individual exercise. This should encourage collaborative learning and team learning and also self-study.

Internal assessment marks must be decided well before the commencement of Semester End examinations

Semester End Examination: The Semester End Examination is for 50 marks shall be held in the 18th and 19th week of the semester and the entire course syllabus must be covered while setting the question paper.

Semester End Examination paper is set for a maximum of 100 marks to be answered in 3 hours duration. Each main question be set for a maximum of 25 marks, main questions can have a 3-4 sub questions. A total of 8 questions are set so that students will have a choice. Each question is set using Bloom's verbs. The questions must be set to assess the students outcomes described in the course document. (Please note question papers have to be set to test the course outcomes)

There shall be three sets of question papers for the semester end examination of which one set along with scheme of examination shall be set by the external examiners and two sets along with scheme of examination shall be set by the internal examiners. All the three sets shall be scrutinized by the Board of Examiners. It shall be responsibility of the Board of Examiners particularly Chairman of the BOE to maintain the quality and standard of the question papers and as well the coverage of the entire syllabus of the course.

There shall be single evaluation by the internal teachers who have taught the subject. However, there shall be moderation by the external examiner. In such cases where sufficient number of external examiners are not available to serve as moderators internal senior faculty member shall be appointed as moderators.

Board of Examiners, question paper setters and any member of the staff connected with the examination are required to maintain integrity of the examination system and the quality of the question papers.

There shall also be an Program Assessment Committee (PAC) comprising at-least 3 faculty members having subject expertise who shall after completion of examination process and declaration of results review the results sheets, assess the performance level of the students, measure the attainment of course outcomes, program outcomes and assess whether the program educational objectives are achieved and report to the Director of the School. The Examination Review Committee shall also review the question papers of both Internal Tests as well Semester End Examinations and submit reports to the Director of the respective School about the scope of the curriculum covered and quality of the questions.

The report provided by the Examination Review Committee shall be the input to the Board of Studies to review and revise the scheme of instruction and curriculum of respective program

During unforeseen situation like the Covid-19, the tests and examination schedules, pattern of question papers and weightage distribution may be designed as per the convenience and suggestions of the board of examiners in consultation with COE and VC

University may decide to use available modern technologies for writing the tests and SEE by the students instead of traditional pen and paper

Any deviations required to the above guidelines can be made with the written consent of the Vice Chancellor

Online courses may be offered as per UGC norms.

For online course assessment guidelines would be as follows:

If the assessment is done by the course provider, then the school can accept the marks awarded by the course provider and assign the grade as per REVA University norms.

If the assessment is not done by the course provider, then the assessment is organized by the concerned school and the procedure explained in the regulation will apply

In case a student fails in an online course, s/he may be allowed to repeat the course and earn the required credits

IAs for online courses could be avoided and will remain the discretion of the school.

The online platforms identified could be SWAYAM, NPTEL, Coursera, Edx.org, Udemy, Udacity and any other internationally recognized platforms like MIT online, Harvard online etc.

Utilization of one or two credit online courses would be:

4 week online course – 1 credit

8 week online course / MOOC – 2 credits

12 week online course / MOOC – 3 credits

Summary of Internal Assessment, Semester End Examination and Evaluation Schedule is provided in the table given below.

Summary of Internal Assessment and Evaluation Schedule

Sl. No.	Type of Assessment	when	Syllabus Covered	Max Marks	Reduced to	Date by which the process must be completed
1	Test-1	During 6th week	First 40%	30	15	7th week
2	Test -2	During 12th Week	Second 40%	30	15	13th Week
3	Assignment / Quiz	15th Week	Last 20%	20	20	16th Week
4	SEE	18/19th Week	100%	100	50	20th Week

Assessment of Students Performance in Practical Courses

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

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

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

i	Conduction of regular practical / experiments throughout the semester	20 marks
ii	Maintenance of lab records	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**

10.2 The 50 marks meant for Semester End Examination (SEE), shall be allocated as under:

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

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

For MOOC and Online Courses assessment shall be decided by the BOS of the School.

For > 3 credit courses

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

For 1 & 2 credit courses

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

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	Periodic Progress and Progress Reports (25%)
Component – II	Demonstration and Presentation of work (25%)
Component – III	Evaluation of Report (50%)

Requirements to Pass a Course:

A candidate's performance from IA and SEE will be in terms of scores, and the sum of IA and SEE scores will be for a maximum of 100 marks (IA = 50, SEE = 50) and have to secure a minimum of 40% to declare pass in the course. However, a candidate has to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) which is compulsory.

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

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

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

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

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 in a given semester, i.e : SGPA (Si) = $\sum(Ci \times Gi) / \sum Ci$ where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade)**
Course 1	3	A+	9	3X9=27
Course 2	3	A	8	3X8=24
Course 3	3	B+	7	3X7=21
Course 4	4	O	10	4X10=40
Course 5	1	C	5	1X5=5
Course 6	2	B	6	2X6=12
Course 7	3	O	10	3X10=30
	19			**159**

Thus, SGPA = 159 ÷ 19 = 8.37

Illustration No. 2

Course	Credit	Grade letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	C	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			**175**

Thus, SGPA = 175 ÷ 24 = 7.29

Illustration No.3

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade point)
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36
Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			**199**

Thus, SGPA = 199 ÷ 24 = 8.29

Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (160) for B. Tech degree in Engineering & Technology is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e : $CGPA = \sum(Ci \times Si) / \sum Ci$

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

Illustration:

CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	19	6.83	19 x 6.83 = 129.77
2	21	7.29	21 x 7.29 = 153.09
3	22	8.11	22 x 8.11 = 178.42
4	22	7.40	22 x 7.40 = 162.80
5	22	8.29	22 x 8.29 = 182.38
6	22	8.58	22 x 8.58 = 188.76
7	22	9.12	22 x 9.12 = 200.64
8	10	9.25	10 x 9.25 =92.50
Cumulative	**160**		**1288.36**

Thus, CGPA = 19x6.83+21x7.29+22x8.11+22x7.40+22x8.29+22x8.58+22x9.12+10x9.25 = 8.05

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 8.05 x 10=80.5

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

Classification of Results

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

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

Overall percentage=10*CGPA

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).

Final Grade Card: Upon successful completion of B. Tech Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examinations.

14. Attendance Requirement:

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

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

14.3 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

15. Re-Registration and Re-Admission:

15.1 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.

15.2 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.

Absence during Internal Test:

In case a student has been absent from an internal test due to the illness or other contingencies he / she may give a request along with necessary supporting documents and certification from the concerned class teacher / authorized personnel to the concerned 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.

17. Provision for Appeal

17.1. 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.

18. **Grievance Committee:**

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.

Eligibility to Appear for Semester End Examination (SEE)

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

Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, 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.

Provision to Carry Forward the Failed Subjects / Courses:

The student who has failed in a maximum of 4 courses in odd and even semesters together shall move to next semester of succeeding year(s) of study till 8th semester. And he / she shall appear for Semester End examination of failed courses of previous semesters concurrently with odd semester end examinations and / or even semester end examinations of current year of study.

Examples:-

Student “A” has failed in 1 Course in First Semester and 3 Courses in Second Semester. He / she is eligible to seek admission for Third Semester and appear for Semester End Examination of 1 failed Course of First Semester concurrently with Third Semester end examination. Likewise, he / she is eligible to appear for Semester End Examination of 3 failed Courses of Second Semester concurrently with Fourth Semester end examination.

Student “B” has failed in 2 Courses of First Semester and 2 Courses in Fourth Semester and has passed in all Courses of First and Second Semesters. He / she is eligible to seek admission to Fifth Semester and appear for

Semester End Examination of 2 failed Courses of First Semester concurrently with Fifth Semester end examination. Likewise he / she is eligible to appear for Semester End Examination of 2 failed Courses of Fourth Semester concurrently with Sixth Semester end examination.

Student "C" has failed in one course in Second Semester one course in third semester and two courses in fifth semester and has cleared all other courses from first semester to Sixth Semester. He / She has also passed all the courses of First to Sixth Semesters. Student "C" is eligible to seek admission for Seventh Semester and appear for Semester End Examination of one failed Course of Second Semester, one course of third semester and two courses in fifth semester concurrently with Seventh Semester end examination. However, he / she has to pass all the failed courses of Second Semester, Third Semester and Fifth Semester along with Seventh and Eighth Semesters courses to earn B. Tech Degree.

Student "D" failed in three courses in first semester and one course in second semester, but has passed in all the courses of second to sixth semester. Student "D" is also eligible to seek admission for 7th Semester and appear for Semester End Examination of 3 failed courses of 1st Semester and one course of second semester concurrently with 7th Semester and 8th semester end examinations. However, he / she has to pass three failed courses of first semester and one failed course of second semester along with Seventh and Eighth Semester courses to earn B. Tech Degree.

The student failed in any course(s) in any of the first to eight semesters has to pass all the failed courses of all Semesters within the double duration to earn B. Tech Degree failing which he / she has to seek re-admission to the program afresh.

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.

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

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.

REVA UNIVERSITY
Bengaluru, India

School of Computing and Information Technology
Scheme of Instructions (2020 – 2024 Batch)
B. Tech CS &SE

I SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20AS0105	Multivariable Calculus and Linear Algebra	HC	3	0	0	3	3
2	B20EE0101	Basics of Electrical and Electronics Engineering	HC	3	0	1	4	5
3	B20CI0101	Introduction to Python Programming	FC	2	0	1	3	4
4	B20AS0104	Engineering Chemistry	HC	3	0	0	3	3
TOTAL				**11**	**0**	**2**	**13**	**15**
	Practical /Term Work / Practice Sessions /MOOCs							
5	B20ME0102	Design Thinking	FC	1	0	1	2	3
6	B20AS0109	Biology for Engineers	FC	1	0	0	1	1
7	B20ME0101	Computer Aided Engineering Drawing	HC	2	0	1	3	4
TOTAL				**4**	**0**	**2**	**6**	**8**
TOTAL SEMESTER CREDITS							**19**	
TOTAL CUMULATIVE CREDITS							**19**	
TOTAL CONTACT HOURS							**23**	

II SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20AS0204	Probability and Statistics	HC	4	0	0	4	4
2	B20AS0106	Physics for Computer Science	HC	3	0	0	3	3
3	B20CS0101	Introduction to Data Science	FC	2	0	1	3	4
4	B20CE0201	Basics of Civil and mechanical Engineering	HC	3	0	1	4	5
5	B20CS0102	Programming for Problem Solving	HC	3	0	1	4	5
TOTAL				**15**	**0**	**3**	**18**	**21**
	Practical /Term Work / Practice Sessions /MOOCs							
6	B20EC0101	IoT and Applications	FC	1	0	1	2	3
7	B20ME0104	Entrepreneurship	FC	1	0	0	1	1
TOTAL				**2**	**0**	**1**	**3**	**4**

TOTAL SEMESTER CREDITS	**21**
TOTAL CUMULATIVE CREDITS	**40**
TOTAL CONTACT HOURS	**25**

III SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20CI0301	Analog and Digital Electronics	HC	3	0	1	4	5
2	B20CI0302	Programming with JAVA	HC	3	0	1	4	5
3	B20CI0303	Data Structure and Algorithms	HC	3	0	1	4	5
4	B20AS0302	Discrete Mathematics and Graph Theory	HC	3	0	0	3	3
5	B20EK0301	Computer Organization and Architecture	HC	3	0	0	3	3
TOTAL				**15**	**0**	**3**	**18**	**21**
	Practical /Term Work / Practice Sessions /MOOCs							
6	B20MGM301	Management Science	FC	2	0	0	2	2
7	B20AS0301	Environmental Science	FC	2	0	0	2	2
8	B20AHM301 OR B20AHM302	Advanced Kannada OR Basics of Kannada	MC	0	0	0	0	0
TOTAL				**4**	**0**	**0**	**4**	**4**
TOTAL SEMESTER CREDITS							**22**	
TOTAL CUMULATIVE CREDITS							**62**	
TOTAL CONTACT HOURS							**25**	

IV SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20CI0401	Design and Analysis of Algorithms	HC	3	0	1	4	5
2	B20EK0401	Device Driver Programming	HC	3	0	0	3	3
3	B20CI0402	Unix Operating System	HC	3	0	1	4	5
4	B20CI0403	Database Management System	HC	3	0	1	4	5
5	B20EK0402	Microprocessors and Interfacing	HC	3	0	0	3	3
6	B20AS0401	Numerical Methods and Optimization Techniques	HC	3	0	0	3	3
TOTAL				**18**	**0**	**3**	**21**	**24**
Practical /Term Work / Practice Sessions /MOOCs								
7	B20AH0301	Communication Skills	FC	2	0	0	2	2
8	B20LS0301	Indian Constitution and Professional Ethics	FC	2	0	0	2	2
9	B20AHM401	Universal human values	MC	0	0	0	0	0
TOTAL				**4**	**0**	**0**	**4**	**4**

TOTAL SEMESTER CREDITS	**25**
TOTAL CUMULATIVE CREDITS	**87**
TOTAL CONTACT HOURS	**28**

V SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/SC/OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EJ0501	Web Technology	HC	3	0	2	5	7
2	B20CI0501	Computer Networks	HC	3	0	1	4	5
3	B20EK0501	Smart Sensors and Transducers	HC	3	0	0	3	3
4	B20CI0502	Machine Learning	HC	3	0	1	4	5
5	B20EXS5(01-06)	Professional Elective-I	SC	3	0	0	3	3
6	B20XXO5XX	Open Elective-I	HC	3	0	0	3	3
TOTAL				**18**	**0**	**4**	**22**	**26**
Practical /Term Work / Practice Sessions /MOOCs								
6	B20CI0503	Technical Documentation	FC	1	0	0	1	1
7	B20EA0501	AI & Humanity	FC	2	0	0	2	2
TOTAL				**3**	**0**	**0**	**3**	**3**
TOTAL SEMESTER CREDITS							**25**	
TOTAL CUMULATIVE CREDITS							**112**	
TOTAL CONTACT HOURS							**29**	

VI SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EK0602	IOT and Cloud Programming	HC	3	0	0	3	3
2	B20EA0601	Big Data Analytics	HC	3	0	1	4	5
3	B20EXS6(01-06)	Professional Elective-II	SC	3	0	0	3	3
4	B20EXS6(07-09)	Professional Elective-III	SC	3	0	0	3	3
5	B20EKX6(10-12)	Professional Elective-IV	SC	3	0	0	3	3
6	B20XXO6XX	Open Elective-II	HC	3	0	0	3	3
TOTAL				**18**	**0**	**1**	**19**	**20**
Practical /Term Work / Practice Sessions /MOOCs								
7	B20CI0601	Research Based Mini Project	HC	0	0	2	2	4
8	B20PA0501	Indian Tradition and Culture	FC	1	0	0	1	1
9	B20EA0602	Brain Machine Interface (BMI)	FC	1	0	1	2	3
TOTAL				**2**	**0**	**3**	**5**	**8**
TOTAL SEMESTER CREDITS							**24**	
TOTAL CUMULATIVE CREDITS							**136**	
TOTAL CONTACT HOURS							**28**	

VII SEMESTER

Sl. No	Course Code	Title of the Course	HC/FC/ SC/ OE	Credit Pattern & Credit Value				Contact Hours/ Week
				L	T	P	Credits	
1	B20EKS7(01-03)	Professional Elective-V	SC	3	0	0	3	3
2	B20XXO7(XX)	Open Elective-III	OE	3	0	0	3	3
TOTAL				**6**	**0**	**0**	**6**	**6**
Practical /Term Work / Practice Sessions /MOOCs								
3	B20CI0701	Summer Internship/Global Certification	HC	0	0	3	3	6
4	B20CI0702	Project Phase-I	HC	0	0	4	4	8
TOTAL				**0**	**0**	**7**	**7**	14
TOTAL SEMESTER CREDITS							**13**	
TOTAL CUMULATIVE CREDITS							**149**	
TOTAL CONTACT HOURS							**20**	

VIII SEMESTER

Sl.	Course Code	Title of the Course	HC/FC/	Credit Pattern &	Contact

No			SC/ OE	Credit Value				Hours/ Week
				L	T	P	Credits	
1	B20CI0801	Capstone-Project Phase-II	HC	0	0	8	8	16
TOTAL				**0**	**0**	**8**	**8**	**16**
Practical /Term Work / Practice Sessions /MOOCs								
2	B20XXO8XX	Open Elective-IV	OE	3	0	0	3	3
TOTAL				**3**	**0**	**0**	**3**	**3**
TOTAL SEMESTER CREDITS							**11**	
TOTAL CUMULATIVE CREDITS							**160**	
TOTAL CONTACT HOURS							**19**	

Professional Electives in System Engineering Stream

	Code	Course	Code	Course	Code	Course
PE-I/V sem	B20EKS501	Introduction to Robotics and Drones	B20EKS503	Cryptography and Network Security	B20EKS505	Storage Area Networks
	B20EAS504	Fuzzy Logic and Systems	B20EKS502	Predictive Analytics using PYTHON	B20EKS506	Digital System Design with Verilog
PE-II/ VI sem	B20EJS606	Neural Networks and Deep learning	B20EJS604	Block Chain Technology	B20EKS605	System-on-Chip Design
	B20EKS601	Text and Web Mining	B20EKS602	High Performance Computing	B20EKS603	Distributed Computing and Parallel Systems
PE-III/ VI sem	B20EJS607	Computer Vision and Applications	B20EJS608	Advanced Topics in Wireless Networks	B20EJS609	Compiler Design
PE-IV/ VI sem	B20EKS610	Advanced Topics in Machine Learning	B20EKS611	Advanced Computer Architecture	B20EKS612	Embedded Systems
PE-V/ VII sem	B20EAS701	Swarm and Bio-inspired Intelligence	B20EKS703	System Modelling and Simulation	B20EKS702	Augmented and Virtual Reality

Open Electives Offered to Other schools											
5TH SEM /OE-I			**6th SEM /OE-II**			**7th SEM /OE-III**			**8th SEM /OE-IV**		
Course code	Course Name	Teaching School	Course code	Course Name	Teaching School	Course code	Course Name	Teaching School	Course code	Course Name	Teaching School
B20CIO501	Introduction to AI	CIT	B20CIO601/602	Data Mining/Machine Learning	CIT	B20CIO701	Python for data science	CIT	B20CIO801	IoT Programming	CIT
B20CIO502/503	OOPS with c++/Web technology	CIT	B20CIO603	Neural Networks	CIT	B20CIO702	Deep Learning	CIT	B20CIO802	Reinforcement Learning	CIT

Skill Development Programs

Skill Development Programs (by Clubs/Industries/Corporate-Trainers/School-Faculty)		
GitHub and Open Source Technologies	Project Development Tools	Ethical Hacking
CyberSecurity and Forensics	Cyber Physical Systems	IOT And Cloud Convergence
Graphics With Open Source Tools	AR And VR With UNITY Software	Robotic Process Automation
Data Analysis Using Python	Python And ML	Data Analysis With R
Mongo dBand NOSQL	Django And Python	Full Stack Development
DevOpsTools	Linux System Administration	Cloud Administration
Network Administration	Software Testing with Scrum	Software Project Management
Bigdata Using Spark/Hadoop	Excel And SQL For Data Analysis	AWS Cloud and DevOps
Azure Cloud and DevOps	Google Cloud and DevOps	Coding And Programming Skills
Android Application Development	IOS Application Development	NLP With Python
Social Media Analytics	JavaScript For Web Design	Micro Website Design Google Web Designer
Algorithms Thinking and Data Structures	UI Design	Storage System Management
Digital SEO/Sem Marketing	Web Services (Restful Services in Java, Etc.)	Digital Photography with Photoshop
Network Programming	WSN And IOT Programming	Image Processing Using Python
5G And IOT	Sentiment Analysis	Machine Learning And IOT
System Integration Tools	Computational Biology Using Python	C# And .Net
Kotlin Programming	Julia Programming	Objective C Programming
JavaScript For CyberSecurity	C++ Programming For Automotive Applications	E-Commerce Site Design
Banking And Insurance Using Python	MATLAB For Scientific Computing	Network Simulator NS3

Certification Programs		
EC Council: Certified Ethical Hacker	EC Council: CHFI Certified Hacking Forensics Investigator	Cisco: CCNP Security
CWNP: CWNS Certified Wireless Network Security Professional	ISACA: Certified Information Security Manager	Juniper: Juniper Network Certified Internet Professional
AWS: Certified Solutions Architect Professional	AWS: Certified DevOps Engineer	AWS: Certified Security Speciality
Google: Certified Professional Cloud Architect	Google: Associate Cloud Engineer	Red Hat: RHSCA in Red Hat OpenStack
Professional Cloud Developer	IBM: Certified System Administrator	IBM: Certified Database Administrator
PSC: Scrum Certification	Microsoft: Advanced MS Excel	PMI: PMP Certification
COBIT: IT Service Management Certification	VMWare: Advanced Certified Professional – Data Centre Virtualization	VMWare: Certified Professional Network Virtualization
IBM: Certified Application Developer	IBM: AI Certification	IBM: Data Science Professional Certificate
Wireshark: Certified Network Analyst	Cisco: CCNA Network Associate	Cisco: CCNP Enterprise
CWNP: WIFI administration	CWNP: Wireless Security Professional	Kubernetes and Red Hat OpenStack /AWS
VMWare: Certified Professional Cloud Management and Automation	Oracle: Business Intelligence	Oracle: Enterprise Management
Oracle: Virtualization	Red Hat: Microservices Certification	Block Chain Council: Blockchain Certification
DLA:Certified REST API Practitioner	Cloud Credential Council: IOT Certification	Microsoft:DevOps Engineer
Microsoft: Azure Data Engineer	Microsoft: Azure Administrator	Microsoft: Azure AI Engineer

Detailed Syllabus
Semester 1

<table>
<tr><td>Course Title</td><td colspan="4">Multivariable Calculus and Linear Algebra</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0105</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Differential Calculus deals with the basic aspect's differential calculus. The students of Computer Science are equally benefited with this course as stepping stone to the broad areas of calculus. This course familiarizes students with important concepts coming under differential calculus and to develop strong foundations on these concepts.In Computer Science, Calculus is used for machine learning, data mining, scientific computing, image processing, and creating the graphics and 3D visuals for simulations. Calculus is also used in a wide array software program that require it.Linear algebra provides concepts that are crucial to many areas of computer science, including graphics, image processing, cryptography, machine learning, optimization, graph algorithms, information retrieval and web search.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the scalar product and vector product of two or more vectors.
2. Illustrate how to find angle between polar curves with a suitable example.
3. Demonstrate the use of radius of curvature of the curves can be best suited for machine learning techniques with big data analytics.
4. Describe the concepts of Linear algebra and calculus theory.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply Taylor's and Maclaurin's series for finding series expansions of functions and approximating values. expansions of functions and approximating values.	1-6	1,2
CO2	Identify and evaluate the radius of curvature of the given curve. Also evaluate the given indeterminate form using L' Hospital rule.	1-6	1,2
CO3	Make use of Gauss elimination and Gauss Jordon method for solving the system of equations, if the given system of equations is consistent.	1-6	1,2
CO4	Determine the Eigen values, the corresponding Eigen vectors and diagonalizable the given square matrix.	1-6	1,2
CO5	Learn new tools and technologies in the linear algebra and apply for suitable application development.	12	1,2
CO6	Develop solutions in the linear algebra to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	2, 3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	**Bloom's Level**					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyse(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓		✓	
CO3			✓			
C04			✓			
CO5			✓			
CO6			✓	✓		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1							3	3	
CO2	3	3	3	3	3	1							3	3	
CO3	3	3	2	2	3	1							2	2	
C04	2	3	2	3	3	1							1	1	
CO5												2	2	2	
CO6					2				2	2				2	3

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

COURSE CONTENT
THEORY

Contents
UNIT – 1 **Introduction to Vector Differentiation:** Introduction, Scalar and vector point functions, velocity, acceleration, Gradient, Divergence, Curl, Laplacian, Solenoidal and Irrotational vectors, Vector identities**.** **Differential Calculus-1**:Successive differentiation- nth derivatives of standard functions (no proof) simple problems, Leibnitz Theorem (without proof) and problems, Taylor's series and McLaurin's series expansion for function of one variable(only problems), Polar curves- Angle between the radius vector and the tangent, angle between two curves, Pedal equation for polar curves. Applications in computer science.
UNIT-2 **Differential Calculus-2:** Derivative of arc length – concept and formulae (without proof), Radius of curvature-Cartesian, parametric, polar and pedal forms (with proof) problems. Indeterminate forms and solution using L'Hospital's rule. Analysis of Randomized algorithms using Differential Calculus. Applications in computer science.
UNIT-3 **LinearAlgebra-1:** Basic concepts, Echelon form, normal form of a matrix, Rank of Matrix, Gauss-Jordon method to find inverse of a matrix, consistency of linear system of equations, Gauss elimination and Gauss-Jordon method to solve system of equations. Linear Algebra for statistics. Applications in computer science.
UNIT-4 **Linear Algebra-2:** Linear Transformations, orthogonal transformation, Eigen values and Eigen Vectors. Complex matrices, Similarity of Matrices, Diagonalization. Rayleigh power method to determiner largest Eigen value and the corresponding Eigen vector. Analysis of Randomized algorithms using Linear Algebra. Applications in computer science.

TEXTBOOKS:

1. Theodore Shifrin, “Multi-Variable Calculus and Linear Algebra with Applications”, Wiley, 1st Edition, Volume 2, 2018.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43nd edition, 2015.
3. Erwin Kreyszig, “Advanced Engineering Mathematics”, Wiley Publications, 9th edition,2013.
4. Ron Larson, “Multivariable Calculus, Cengage Learning”, 10th Edition, 2013.

REFERENCE BOOKS:

1. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publications, 19th Reprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, “Advanced Engineering Mathematics”, Narosa Publishing House, 4th edition, 2016.
3. Stanley I. Grossman, “Multivariable Calculus, Linear Algebra, and Differential Equations”, 2nd Edition, Academic Press 1986.

JOURNALS/MAGAZINES

https://www.sciencedirect.com/journal/linear-algebra-and-its-applications

SWAYAM/NPTEL/MOOCs:

1. https://youtu.be/XzaeYnZdK5o
2. https://youtu.be/KSntcGOFdUc
3. https://youtu.be/LJ-LoJhbBA4

SELF-LEARNINGEXERCISES:

1. Vectors in Space, Generalized Leibniz Rules, Mean Value of Derivatives, Powers of a matrix,
2. Testing of Linear Dependence and Independence and multivariate calculus. Introduction to differential equations.

<table>
<tr><td>Course Title</td><td colspan="4">Basic Electrical and Electronics Engineering</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EE0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>1</td><td rowspan="2">Theory Hours</td><td rowspan="2">Practical Hours</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>4</td><td>39</td><td>26</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW

Basic Electrical & Electronics Engineering covers basic concepts of electrical engineering and electromagnetism. This course introduces the student to the working AC and DC Machines. It also helps the student to understand the basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes in rectifiers, filter circuits. Further, it has a self-learning component on BJT's.

COURSE OBJECTIVE (S):

1. Explain the basics of electrical and electronics engineering terminologies.
2. Distinguish the single and three phase systems.
3. Illustrate the different building blocks in digital electronics using logic gates and explain simple logic functions using basic universal gates.
4. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
5. To build a broad concept for hands on experience in various types of electrical apparatus, tools and instrumentation with electrical safety norms.
6. To analyze the schematics for making electrical connection and to interpret experimental data for various electrical appliances.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the basics of electrical engineering terminology and the usage.	1-6	1
CO2	Analyze the concepts and applications of DC & AC Machines.	1-5	1
CO3	Apply the concept of domestic wiring, importance of safety and sensing devices	1-5,10	1
CO4	Analyze the different building blocks in digital electronics using logic gates and applications of diode in rectifiers, filter circuits and wave shaping.	1-5	1
CO5	Interpret, Identify and use appropriate electrical tools for electrical connections and to repair electrical equipment's.	1-7, 9,10	1,2

CO6	Compare experimental results with theoretical analysis and the ability to critically evaluate the performance of electrical appliances.	1-7, 9,10	1,2

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

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

COURSE CONTENT:
THEORY:

CONTENTS
UNIT-1
Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Resistive, Inductive, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations, Network Theorems (Superposition, Thevenin's & Norton's) Generation of an alternating Emf–average and rms values of alternating quantity–representation of alternating quantities by phasors–single phase series and parallel circuits (simple problems), three phase systems and power calculations
UNIT-2
DC-Machines: Construction and Principle of operation of DC Machines–Emf & Speed equations-types–applications. AC-Machines: Principle of operation of single phase transformers–Emf equation–losses– efficiency and regulation-Construction and working principle of induction motors–Slip–torque characteristics–applications-Construction and Principle of operation of alternators applications.
UNIT-3
Instruments: Basic Principle of indicating instruments–PMMC&MI instruments. Tariff, Protective Devices and Sensors: Tariff schemes, basic concepts of domestic wiring and types, Earthing, protective fuses, MCB, sensors: pressure sensors, strain gage, proximity sensors, displacement sensors, Rotatory encoder and ultrasonic sensors and civil engineering applications.
UNIT-4
Diodes: Introduction, Physical operation of p-n junction diodes, Characteristics of p-n junction diodes, Zener diode, Rectifier circuits (half-wave, full-wave, bridge and peak rectifiers),Light emitting diodes. Digital Electronic Principles: Introduction, Binary digits, Logic levels and Digital waveforms, Introduction to basic logic operation, Number system, Decimal numbers, Binary numbers, Decimal-to-Binary conversion, Simple binary arithmetic.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Electrical Safety Training. a) To Study the importance of Earthing during accidental shorting of line wire and the body of equipment.	Trainer kitOhms Law Fall of resistance	Importance & applications of Earthing, Fuse & MCB
	b) To conduct experiment and to know the Importance and mechanism of FUSE		
	c) To study the Importance and mechanism of MCB.		
2.	Home Electrical Wiring Demonstration. a) To study & verify the connection procedure for fluorescent lamp wiring.	Fluorescent Lamp wiring Panel Fan with switch and regulator Kit	Connection & Trouble shooting of fluorescent lamp wiring & Fan with switch and regulator
	b) To study the connection of Fan with switch and regulator.		

3.	Two-way switch/ staircase wiring. To study & verify the connection procedure for two-way switch or staircase wiring	Two-way switch or staircase wiring Kit	Connection, Working & application of Two-way switch
4.	Behaviour of current and voltage in series andparallel circuits. a)To study and verify the behaviour of current and voltage in series circuit. b) To study and verify the behaviour of current and voltage in parallel circuit.	Series and parallel circuits Kit	Connection & behaviour of current & voltage in series, parallel circuit
5	Polarity test on single phase transformer. a)To determine the additive polarity of a single-phase transformer. b) To determine the subtractive polarity of a single-phase transformer.	Transformer Kit	Polarities of single phase transformer
6	Determination of VI characteristics of Zener Diode	VI characteristics of Zener Diode kit	VI characteristics of Zener Diode
7	Determination of VI characteristics of Silicon Diode	VI characteristics of Silicon Diode kit	VI characteristics of Silicon Diode
8	Analyze the Half Wave and Full Wave rectifiers using Diode with and without filter	Rectifier kit	Determine the efficiency, Voltage regulation, ripple factor
9	Determine the Characteristics of BJT in Common Emitter Configuration	Characteristics of BJT inCommon Emitter	Input & Output Characteristics of BJT
10	Determine the Characteristics of JFETin Common Source Configuration	Characteristics of JFET in Common	Input & Output Characteristics of JFET
11	Realization of Universal gates using basic logic gates.	Trainer kit	Universal gates will be realized using basic gates

TEXTBOOKS:

1. Nagrath I.J. and D. P. Kothari, “Basic Electrical Engineering”, Third Edition Tata McGraw Hill, 2009.
2. Hayt and Kimberly, “Engineering Circuit Analysis”, 8th Edition, Tata McGraw Hill, 2013.
3. Kulshreshtha D.C., “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall, India, 2009.
5. Hughes, E., “Electrical Technology”, Pearson, 2005.
6. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th Edition, 2008.
7. D.P. Kothari, I. J. Nagrath, “Basic Electronics”, McGraw Hill Education (India) Private Limited, 2014.

REFERENCEBOOKS:

1. Theodore Wildi, “Electrical Machines, Drives, and Power, 5thSystems”, Pearson Edition, 2007.
2. Hughes, “Electrical Technology”, International Students 9th Edition, Pearson, 2005.

JOURNALS/MAGAZINES

1. International Journal of Electrical Power and Energy Systems (https://www.journals.elsevier.com/international-journal-of-electrical-power-and-energy-systems)
2. Journal of Electrical Engineering (https://link.springer.com/journal/202)

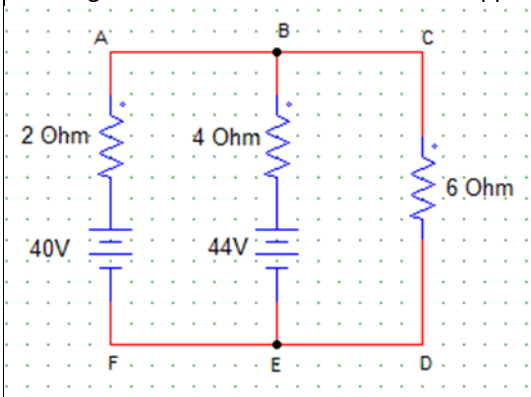
SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/108/108/108108076/

SELF-LEARNINGEXERCISES:

1. Build an electrical circuit using BJT as a switch
2. Identifying the practical application of Electromagnetic Induction

PROBLEMBASEDLEARNING

No	Problems
1	A current of 20A flows through two ammeter A and B in series. Potential difference across A is 0.2V and across B is 0.8 V. Find how the same current will divide between A and B when they are joined in parallel.
2	For the given circuit calculate the current supplied by each battery and current in 6 ohm resistor. 
3	Two 12V batteries with internal resistances 0.2 ohm and 0.25 ohm respectively are joined in parallel and a resistance of 1 ohm is placed across the terminals. Find the current supplied by each battery.
4	A 6 pole induction motor is connected to a 50 Hz supply. It is running at a speed of 970 R.P.M. Find the synchronous speed and the slip
5	If A= $(1011)_2$ and B = $(1110)_2$, perform the following arithmetic operations. i)Addition ii) subtraction ii) Multiplication
6	Simplify the given Boolean expression and implement using logic gates. i)Y=AB+ABC+AB(D+E) ii) Y=ABCD+ABD iii) Y=AB+A(B+C)+B(B+C)
7	Simplify the given Boolean Expression: i) Y= XY+XYZ+XY$\bar{Z}$+$\overline{XYZ}$ ii) $Y = \bar{A}\bar{B}$C+$\bar{A}$B$\bar{C}$+$\bar{A}$BC iii) Y= AC+C(A+$\bar{A}$B)
8	a) Perform the following operations: (i)Convert $(01110111)_2$ to decimal (ii) Convert $(21)_{10}$ to binary (iii) Add: $(1010)_2$ and $(0011)_2$ (iv) Subtract: $(111.111)_2$ from $(1010.01)_2$ (v) Divide: $(101101)_2$ by $(110)_2$

PROJECT BASED LEARNING

To enhance the skill set in the integrated course, the students are advised to execute course-based Design projects. Some sample projects are given below:

	Suggested Projects
1.	Design & Development of a rectifier circuit
2.	Identify the types of wiring
3.	Electricity bill calculation
4.	Identify the types of motors used in domestic & industrial application with nameplate details.
5.	Identification of different transformer based on their rating used for various applications.

Course Title	Introduction to Python Programming				Course Type		Integrated	
Course Code	B20CI0101	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

Python is a Programming Language that can be treated in a procedural way, an object-orientated way or a functional way. It can be used on a server to create web applications, create workflows, connect to database systems, read and modify files, handle big data and perform complex mathematics. It can implement object oriented features and exception handling, It can parse the strings using regular expressions. It can be used for implementing the machine learning algorithms to develop solutions for interdisciplinary problems apart from any general problems leading to automation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming language constructs and their applications.
2. Inculcate knowledge of parsing of regular expressions and their usage in various application domains.
3. Gain expertise in Object oriented programming and NumPy package.
4. Discuss the files, Pandas and Data Virtualization concepts.

COURSE OUTCOMES (COs)

After the completion of the course, the student wil lbe able to:

CO#	Course Outcomes	POs	PSOs
CO1	Make use of language constructs to solve real world problems using python programming.	1- 4, 8, 9, 12	1
CO2	Develop programs for text processing and other application domains by making use of regular expressions.	1-3, 5,9,12	2
CO3	Apply features of object oriented and NumPy package to develop computationally intensive programming to analyze and interpret the data.	1- 5, 9, 12	3
CO4	Create data science solutions with the help of files, Pandas and Data Visualization.	1,4,5,9,12	1-3
CO5	Learn new tools and technologies in the python and apply for suitable application development.	12	1,2
CO6	Develop solutions in the python 1to the complex problems, either individually or as a part of the team and report the results with proper	5, 9, 10	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

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2				1	1			1	3		
CO2	3	2	3		2				1			1		3	
CO3	3	1	2	1	2				1			1			
CO4	3			2	2				1			1	3	3	3
CO5												1	2	2	
CO6					2				1	1				2	2

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction to Computer Fundamentals: Computer Components, accessories, specifications of computers and external devices. Flowchart symbols and guidelines, types and advantages, Algorithm design. **Python Fundamentals:** Introduction to Python: History, Applications, Your First Python Program, Constants, Variables, Naming conventions, simple data types, Type casting, Assignment statements, expressions, Boolean data type, Trigonometry functions, operators, precedence of operators, libraries, keywords, Python Collections, I/O statements, conditional statements, loops, functions, user defined functions. Introduction to GitHub and applications.
UNIT-2
Strings: Unicode, Formatting Strings, Format Specifiers, other Common String Methods, Slicing a String. Regular Expressions: Case Study: Street Addresses, Case Study: Roman Numerals, Checking for Thousands, Checking for Hundreds, Using the {n,m} Syntax, Checking for Tens and Ones.
UNIT-3
Object Oriented Programming: Defining Classes, The init() Method, Instantiating Classes, OOP features: Abstraction. Encapsulation, Single Inheritance, Polymorphism. Files: Reading from Text Files, Writing to text files, Reading and Writing the Binary Files.
UNIT-4
NumPy: Introduction to NumPy, Creating arrays, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output. Pandas and Data Visualization: Introduction, Series and Data Frames in pandas and Data Visualization.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a). "LIST1" is a list that contains "N" different SRN of students read using a user defined function with the help of input () function. It is required to add SRN of "M" more students that are to be appended or inserted into "LIST1" at the appropriate place. The program must return the index of the SRN entered by user.	Windows/Linux OS, IDE, Jupiter	Create and perform operations on list.
	b)"TUPLE1" and "TUPLE2" are two tuples that contain "N" values of different data types read using theuser defined function "READ" with the help of input() function. Elements of "TUPLE1" and "TUPLE2" are to be read one at a time and the "larger" value among them should be placed into "TUPLE3". Display all tuples.	Windows/Linux OS, IDE, Jupyter	Create and perform operations on Tuples.
2.	a)SET1 and SET2 are two sets that contain unique integers. SET3 is to be created by taking the union or intersection of SET1 and SET2 using the user defined function Operation (). Perform either union or intersection by reading choice from user. Do not use built in functions union () and intersection () and also the operators "|" and "&".	Windows/Linux OS, IDE, Jupyter	Create and perform Union and Intersection, Operations on Sets.
	b)The Dictionary "DICT1" contains N Elements and each element in dictionary has the operator as the KEY and operand's as VALUES. Perform the operations on operands using operators stored as keys. Display the results of all operations.		Create dictionary and perform operation using user defined function.
3.	a)A substring "Substr" between index1 and index2 is to be extracted from the given input string "Str1", which is read using input(). Display the substring "Substr" using a user defined function if available in string "Str1", otherwise display NULL.	Windows/Linux OS, IDE, Jupyter	String operations.
	b) A string containing multiple words is to be read from the user one at a time, after reading perform following operations. Convert all the strings to uppercase and display Split the words of a string using space as the separation character and display.		
4.	a)Consider the text file, "Std.txt", with the details of students like SRN, NAME, SEMESTER, SECTION AND AVG_MARKS. Read the file, "Std.txt" and display the details of all the students of 4th Semester "A" Section who have scored more than 75%.	Windows/Linux OS, IDE, Jupyter	File Handling.
	b)Consider the text file "Emp.txt", with the details of Employees like EMP_CODE, EMP_NAME, BASIC_SALARY, DA, GROSS_SALARY, NET_SALARY, LIC, PF and TOTAL-DEDUCTIONS. Read EMP_CODE, EMP_NAME, BASIC_SALARY, DA, LIC and PF from the user using input() and compute the following: TOTAL_DEDUCTIONS= (LIC+PF) GROSS_SALARY= BASIC_SALARY+ DA NET_SALARY= GROSS_SALARY – TOTAL_DEDUCTIONS. Write the above data to file for each employee. Read the content of "Emp.txt" and display the details of each employee		File Handling.

5.	a). A "CAR" has the attributes COMPANY_NAME, MODEL, COLOR, MANUFACUTING_YEAR and PRICE. A Class is required to be created for "CAR" to store the above attributes and perform the following operations: Get the details of "CAR" object from user and store into Array of objects Display the details of "CAR" object based on "COMPANY", "MODEL" and "PRICE".	Windows/Linux OS, IDE, Jupyter	Classes and objects usage.
	b). Airline Reservation System contains the attributes of passengers such as NAME, PAN_NO. MOBILE_NO, EMAIL_ID, SOURCE, DESTINATION, SEAT-NO, AIR-FARE and TRAVEL_DATE. A Class is required to be created for "Airlilne" with the above attributes and perform the following operations: Get the details of "Airline" object from user and store into Array of objects List details of all the passengers who travelled From "Bengaluru to London". List details of all the passengers who travelled From "Chicago to Beijing" on 10th of Feb, 2020.		
6.	a). "Arr_1" is an integer array of size M x N. Size and content of the array is to be read using input() by using the user defined function READ_DATA(). It is required to display the Diagonal elements of"Arr_1" Elements of mth row (row no should be entered by user) Elements of n^{th}column (column no should be entered by user)	Windows/Linux OS, IDE, Jupyter	NumPy arrays usability.
	b)The dictionary "DICT1" contains the pass percentage of each semester of B. Tech in CSE, where, "Semester" acts as the key and "Pass Percentage" acts as the value. A Python Pandas dataframe is required to be created using the dictionary "DICT1" and display it using a user defined function.		Pandas Series usability.
	Part-B (Mini Project: Library Management System)		
1.	Develop a program to create the class "USER" with the attributes USER_NAME, USER_ID, SCHOOL_NAME, ADDRESS, PHONE_NO, EMAIL_ID, DOB and AGE. The functions add user (), delete user (), edit user (), search user () should be part of the class. Instantiate "User" class with 10 objects. Read the attributes of each "User" object using input () and store them in the file "User_File.txt".	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes of user and store them in a file.
2	Develop a program to get the name of the "User" object whose details are to be deleted. Read the "User_File.txt" and delete the "User" object if found. Display the contents of "User_File.txt" after	Windows/Linux OS, IDE, Jupyter	Create a class user to read the attributes and
3	Develop a program to get the name of the "User" object whose details are to be edited (modified). Edit the details of the user object in the file "User_File.txt" and display the contents after	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
4	Develop a program to create the class "BOOK" with the attributes TITLE, AUTHOR, PUBLISHER, YEAR, PRICE, SCHOOL_NAME and the functions add book(), delete book(), edit book() and search book(). Instantiate "Book" class with 10 objects. Read the attributes of each "BOOK" object using input () and store them in the file	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes of user and store them in a file.
5	Develop a program to get the name of the "BOOK" object whose details are to be deleted. Read the "Book_File.txt" and delete the "BOOK" object whose details match with the data entered. Display the contents of "Book_File.txt" after deletion.	Windows/Linux OS, IDE, Jupyter	Create a class book to read the attributes and delete the object.

6	Develop a program to get the name of the "BOOK" object whose details are to be edited (modified). Edit the details of the "Book" object in the file "Book_File.txt" and display the contents after modification.	Windows/Linux OS, IDE, Jupyter	To create a class and edit the file.
7	Develop a program to create the class "TRANSACTION" with the attributes USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE,DUE_DATE and RETURN_DATE and the functions issue book(), return book() and search book(). Instantiate "Transaction" class with 10 objects. Read the attributes of each "Transaction" object using input () and store them in the file "TransactionFile.txt". Develop a program to issue the book as requested by the user. Update the attributes in "Transaction _File"	Windows/Linux OS, IDE, Jupyter	Create class and perform string operations.
8	Develop a program to return the book. Edit the details of the user like USER_ID, USER_NAME, AUTHOR, TITLE, EDITION, ISSUE_DATE, DUE_DATE and RETURN_DATE in "TransactionFile.txt" and display the contents after modification. Compute the fine amount to be paid if return date is not same as due date. If both return date and due date are same and put zero in fine amount.	Windows/Linux OS, IDE, Jupyter	Create class and perform string operation.
9	Develop a program to search for a book using its "author". Display the message "available" if search is successful otherwise display the message "not available".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
10	Develop a program to get a list of users by referring to "User_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
11	Develop a program to get List of Books in stock by referring to "Book_File.txt" and "Transaction_File.txt".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and regular expressions.
12	Develop a program to get List of Books Issued by referring to "User File", "Book File" and "Transaction File".	Windows/Linux OS, IDE, Jupyter	Create class and object, perform file operations and
13	Develop a project by integrating User, Books, Transaction and Reports Modules.	Windows/Linux OS, IDE, Jupyter	Module integration and project

TEXTBOOKS:

1. Mark Pilgrim, "Dive into Python 3", Apress special edition, second edition, 20l5.
2. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers, 2006.

REFERENCEBOOKS:

1. A B Choudhary, "Flowchart and Algorithms Basics" Mercury Learning and Information,2020
2. Mark Lutz, "Learning Python", Oreilly. 2003.
3. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle& Associates. 2004.
4. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning.
5. Wesley J. Chun, "Core Python Programming", 2nd Edition, Prentice Hall.
6. Steve Holden and David Beazley, "Python Web Programming", New Riders, 2002. Springer, Kent D. Lee, "Python Programming Fundamentals", 2nd Edition.
7. John V. Guttag, "Introduction to Computation and Programming using Python", MIT Press, 2016.
8. https://www.tutorialspoint.com/computer_fundamentals/computer_fundamentals_tutorial.pdf

JOURNALS/MAGAZINES

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596/423/1/012027
4. https://ieeexplore.ieee.org/document/4160250

SWAYAM/NPTEL/MOOCs:

1. Coursera – Python for everybody, University of Michigan
2. Coursera – Python Basics, University of Michigan
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.edx.org/learn/python

SELF-LEARNINGEXERCISES:

1. Explore PYTHON library for IOT programming
2. More exploration on GitHub
3. Data Visualization packages
4. C modules interface

Course Title	Engineering Chemistry				Course Type		Theory	
Course Code	B20AS0104	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	Practical	IA	SEE
	Tutorial	0	0	0				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Engineering chemistry covers very relevant topics compatible with ECE, EEE and C&IT students and make them aware of importance of various aspects of basic science in engineering. The subject of Engineering chemistry covers area of light and matter interaction, clean energy storage and conversion devices, corrosion phenomenon and control which is widely an interdisciplinary subject of discussion. Further the course focus on the chemistry of engineering materials, and various applications. This area of science is very much interdisciplinary in its nature and gives a platform for students to strengthen their engineering knowledge to enlighten on the energy conversion and storage devices, which have become very attractive field of research in engineering stream. The subject deals with various engineering materials, their properties and applications in the field of engineering.

COURSE OBJECTIVE

The Engineering chemistry course is designed to fulfil the following objective;

1. Engineering chemistry covers the very basic knowledge required for engineering students to understand its importance of science in technology.
2. It provides the basic knowledge on Interaction of light and matter to know the electronic transitions in materials
   and storage and conversion devices.
3. Corrosion and metal finishing, explains the phenomenon of corrosion and its Prevention. It also covers the importance of metal finishing in various industries and fabrication of PCB
4. Polymers are all about the properties of various polymeric materials and their Commercial significance. The chapter reveals about technical and commercial Importance of composite materials.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the phenomenon of light and matter interaction to study the materials	1,2, 4,7,11	2
CO2	Demonstrate the electrode processes in Batteries and conversion devices.	6,11	2
CO3	Describe Corrosion phenomenon and precautions to be taken in the selection of materials in controlling corrosion, Fabrication of PCB and industrial applications.	2,4,7,11	2
CO4	Illustrate the properties of polymers, nano materials, composite materials and their applications in various fields.	1,2, 11,12	2
CO5	Learn new tools and technologies in the engineering chemistry and apply for suitable application development.	12	1,2
CO6	Develop solutions in the engineering chemistry to the complex problems, either individually or as a part of the team and report the results with proper analysis	5, 9, 10	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyse (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	PO12	PSO1	PSO2	PSO3
CO1	2	3		1			2				1			2	
CO2						2					2	3		2	
CO3	2	2		2		1	2							2	
CO4		2		2			2				3			2	
CO5												2	2	2	
CO6					2				2	2				2	2

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

COURSE CONTENT

THEORY

Contents
UNIT-1
Light and matter interaction: Electro-magnetic spectrum-Applications in Engineering, Interaction of EM radiation with matter, work function of matter, Electrons in matter. Bonding theories: MOT, Band structure of matters HOMO-LUMO. Photochemical and thermal reactions: Laws of photochemistry, quantum yield, high and low quantum yield reactions. Jablonski diagram - photophysical and photochemical processes, photo-sensitization, photo- polymerization and commercial application of photochemistry.

UNIT-2
CLEAN ENERGY STORAGE AND CONVERSION DEVICES: Introduction to electrochemistry, basic concepts of Batteries and characteristics. Classification: Primary (Dry cell, Li-MnO2) and Secondary (Pb-acid, Li-ion) batteries. Super capacitors: classification, construction and applications in hybrid vehicles. Fuel cells: Alkaline fuel cells, Solid oxide fuel cells and phosphoric acid fuel cell. Photo-conversion devices: Photovoltaic cell, antireflective coating, panels and arrays. Production of single crystal semiconductor by Crystal pulling technique (Czochralski pulling technique), zone refining process (of Si). Problems: Calculation of energy and power density, capacity of a Battery and capacitance of super capacitors for electric vehicle applications.
UNIT-3
Corrosion: Electrochemical theory of corrosion, types of Corrosion- differential metal corrosion, differential aeration corrosion, boiler corrosion, and grain boundary corrosion, Corrosion studies on Al, Fe with pourbiax diagram, Factors affecting rate of corrosion-Primary, secondary. Corrosion control: Galvanizing & tinning, cathodic protection & Anodic Protection. **Metal Finishing:** Theory of electroplating, Factors required to study electroplating Effect of plating variables in electroplating process, Electroplating of gold (acid, neutral and alkaline cyanide bath). Electro less plating of copper and PCB manufacture by Electro less plating of copper. (Applications/case studies).
UNIT-4
CHEMISTRY OF ENGINEERING MATERIALS: Polymer composites: Carbon fiber, Kevlar synthesis and applications, Conducting polymers: synthesis, electron transport mechanism and applications in polyacetylene and polyaniline. Liquid crystals: Introduction classification and applications in electronic display devices. Nanomaterials: Introduction, classification based on dimensionality, quantum confinement. Size dependent properties- surface area, magnetic properties (GMR phenomenon), and thermal properties. Synthesis, Properties and applications of Fullerenes, CNT and Graphene. Sensors: Physical and chemical sensors, Biosensors for bioelectronic applications.

TEXTBOOKS:

1.R.V.Gadag&Nithyanandashetty,"Engineering Chemistry", Ik International Publishing house.

2.S.S. Dara ,"Text Book of Engineering Chemistry", S. Chand & Co.

3.S.S.Chawla,"Text Book of Engineering Chemistry",DhanpatRaiPub.Co.

REFERENCE BOOKS:

1. P.W. Atkins,"Physical Chemistry", 5thedition Oxford.
2. Callister W.D., "Materials Science and Engineering", John Wiley & Sons.
3. R.Gopalan, D.\/enkappaya, S.Nagarajan,"Engineering Chemistry", Vikas Publication.

JOURNALS/MAGAZINES:

1. https://www.sciencedirect.com/journal/water-science-and-technology
2. https://iwaponline.com/wst
3. https://www.scitechnol.com/nanomaterials-molecular-nanotechnology.php
4. https://www.journals.elsevier.com/journal-of-energy-storage

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/105/105/105105201/
2. https://nptel.ac.in/courses/112/108/112108150/

PROBLEM BASED LEARNING

No	Problems
1	Calculation of wavelength and frequencies of the radiations
2	Calculation of band structure by HOMO and LUMO
3	Determination of cell potentials
4	Calculation of energy density and power density of a battery.
5	Determination of capacitance of a super capacitor
6	Crystal field stabilization energy

PROJECT BASED LEARNING

To enhance the skill set in the integrated course, the students are advised to execute course-based

Design projects.

Some sample projects are given below:

No.	Suggested Projects
1.	Collection of literature for the materials for the semi conducting applications
2.	Synthesis of a semiconductor materials for the electronic applications
3.	Construction of a PCB for the electronic device
4.	Synthesis of conducting polymers
5.	Synthesis of Energy storage materials
6.	Fabrication of efficient aqueous battery or super capacitor

Course Title	Design Thinking				Course Type		Integrated	
Course Code	B20ME0102	Credits	2		Class		I Semester	
Design Thinking	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	1	1	1				
	Tutorial	0	0	0	Theory	Practical	IA	SEE
	Practice	1	2	2				
	Total	**2**	**3**	**3**	**13**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Today, innovation is everyone's business. At every level, in every kind of organization, design thinking provides the tools that one needs to become an innovative thinker and uncover creative opportunities. For example, companies like Procter, Gamble and GE have incorporated Design Thinking into their strategy and marketing. The course draws on methods from engineering and design, and combines them with ideas from the arts, tools from the social sciences, and insights from the business world. In this course, students start in the field, where they discover the needs of the target audience. They then iterate ideas on teams to develop a range of promising possible solutions, create rough prototypes to take back out into the field, and learn to test with real people in the target audience.

COURSE OBJECTIVE:

1. To impart knowledge on design thinking process for understanding designs.

2. To provide design skills to analyze design thinking issues and apply the tools and techniques of design.

3. To inculcate attitude to solve societal problems using design thinking tools.

COURSE OUTCOMES (CO's):

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the problems that fall under the purview of human centered design process for creative problem solving.	1,2, 9,10,12	1,2
CO2	Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques	1,2,9,10,12	2
CO3	Build simple prototypes for problems using gathered user requirements.	1,3, 9,10,12	1,2
CO4	Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.	1,4,8,9,10,12	1,2
CO5	Learn new tools, technologies and apply for suitable application development.	12	1, 2
CO6	Develop solutions to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	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

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2							2	2		2	3	2	
CO2	1	3							2	3		2		2	
CO3	2		3						3	3		2	2	3	
CO4	2			2				1	3	2		2	2	3	
CO5												2	2	2	
CO6					2				2					2	2

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

Course Content
Theory

Contents
UNIT-1
Design Thinking Process: Types of the thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking. Problem Exploration, Case Studies from Embrace-Stanford Innovation Challenge, IDEO, GE Healthcare, The Good Kitchen- Denmark Program etc, identifying the target users for the problem selected, Survey on existing solutions for the problem identified. **Empathizing:** Powerful Visualizing tool – a method to connect to the user, Creating Empathy maps – Case studies.
UNIT-2

Defining the problems: POV statements from User perspective. Idea generation: Methods to spark the innovative ideas – Brainstorming, Mind map, Story board, Provocation etc.

What is a prototype? - Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

PRACTICE:

Sl.No	**Name of the Practice Session**	**Tools and Techniques**	**Expected Skill /Ability**
1	Identifying the problem that can be solved using Design Thinking approach	Observation and survey	Develop identifying human centered problems
2	Build the empathy maps for simple problems like single user	Visualization	Develop ability to understand other's emotions
3	Build the detailed empathy maps for problem identified in the teams formed	Visualization	Develop ability to understand other's emotions
4	Presentation by student teams	PPT	Develop ability to express their views
5	Obtain the insights into user's problems and make PoV statement	Understanding	Develop making problem statements from user perception
6	Presentation by student teams	PPT	Develop ability to express their views
7	Carry out Brain storming between the groups and generate as many as ideas possible	Ideation tools	Develop innovative mind set
8	Prototype for best 3 ideas selected	Sketching, simple model making etc	Develop prototyping techniques
9	Presentation by student teams	PPT	Develop ability to express their plan
10	Test the developed prototype with set of identified users	Google forms, cold calls, social media etc.	Develop understanding of various testing methods
11	Pitching final solution	PPT	Develop ability to express their views

TEXT BOOKS:

1. Gavin Ambrose, "Paul Harris,Basics Design-Design Thinking", AVA Publishing, 2010
2. Kathryn McElroy, "Prototyping for Designers: Developing the best Digital and PhysicalProducts", O'Reilly,2017.

REFERENCE BOOKS:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking – New Product Essentials fromPDMA", Wiley, 2015.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in YourOrganization", 2012.

JOURNALS/MAGAZINES/ADDITIONAL SOURCES

1. Leonard, D., and Rayport, J. F. 1997. Spark Innovation through Empathic Design. In HarvardBusiness Review, November-December 1997, 102-113.
2. https://www.ideo.com
3. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
4. https://www.ibm.com/design/thinking/page/toolkit

5. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge- by-creating-your-point-of-view-and-ask-how-might-we
6. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
7. https://youtu.be/M66ZU2PCIcM
8. https://thisisdesignthinking.net/2017/07/innogy_energy_ecarsharing/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/109/104/109104109/
2. https://nptel.ac.in/courses/110106124/

Course Title	**Biology For Engineers**				**Course Type**		**Theory**	
Course Code	B20AS0109	**Credits**	**1**		**Class**		**I semester**	
Course Structure	**TLP**	**Credits**	**Contact Hours**	**Work Load**	**13Hrs/ Semester**		**Assessment in Weightage**	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Understanding biological systems, principles and concepts in order to create usable, tangible, economically viable product or process has become need of the hour. Hence irrespective of the parent engineering discipline, knowledge and expertise from pure and applied sciences is necessary to create product or process related to healthcare, agriculture, environmental issues and many more. Any engineer will have a high probability of using biology related skills and concepts to create products and processes beneficial to the mankind and as well for the sustainable environmental friendly approach. For example, the knowledge can be used to create medical devices, diagnostic equipment's, bioreactor designing, agriculture related equipment/instruments or anything related to surface science, fluid mechanism and polymer science. This course is designed to lay foundation in the field of Cell biology, Molecular biology and Genetics, so that anyone who is interested can design better product/process to enhance the overall quality of life.

COURSE OBJECTIVES:

1. To inculcate the basic concepts of biology from engineering perspective among students
2. To understand the interplay between biology and engineering disciplines
3. To conceptualize the engineering design/process/product for life science challenges

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the biology concepts from engineering perspective.	1	1
CO2	Apply the principles of Biology either for the process/product development from the engineering perspective.	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												2	
CO2	2	2											2	1

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

COURSE CONTENT

THEORY:

CONTENTS
Introduction to Biology, Evolution and Origin of Life, Biomolecules-Lipids, Biomolecules: Carbohydrates, Water, Biomolecules: Amino acids, Proteins, Biomolecules: Enzymes, Biomolecules: Nucleotides, Cell structure and function – Prokaryotes, Cell structure and function – Eukaryotes, Cell cycle-Mitosis and Meiosis, Mendelian genetics: Mendelian inheritance, Genetic diseases and Mendelian inheritance, Central Dogma – Replication, Transcription and Translation.

TEXTBOOKS:

1. G.K. Suraishkumar, "Biology for Engineers", Oxford University Press, 2019.
2. "Biology for Engineers:As per AICTE curriculum", Wiley publication.
3. Dr.Sohini Singh, Dr.Tanu Allen, "Biology for Engineers", Vayu Education of India.

REFERENCE BOOKS:

1. P.S.Verma and V.K. Agarwal, "Cell Biology, Genetics, Molecular Biology", Evolution and Ecology ,2018.
2. Sambamurthy, "Handbook of Genetics", Friends Publisher, 2010 .

JOURNALS/MAGAZINES

1. Current Sciences

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
2. Coursera: Biology everywhere

SELF-LEARNINGEXERCISES:

1. Case study: Computational biology in agriculture and Health Care

2. Artificial Intelligence in health care
3. Image processing for medical applications

PROBLEMBASEDLEARNING

No.	Case Study
1	Case study: Computational biology in agriculture and Health Care
2	Case study: Artificial Intelligence in health care

Course Title	**Computer Aided Engineering Drawing**				**Course Type**		**Integrated**	
Course Code	B20ME0101	**Credits**	**3**		**Class**		**I Semester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	0	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

Engineering Graphics or drawing is known as language of engineers. All phases of engineering process require the conversion of new ideas and design concepts into the basic line language of graphics. There are many areas such as civil, mechanical, electrical, architectural, computer, electronics and industrial applications where knowledge and skills of the drawing play major roles in the design and development of new products or construction. This course emphasizes on projection of point, line, surfaces and solids. It also provides knowledge about representing the object in terms of 3d view and also development of the object.

COURSE OBJECTIVE (S):

1. To introduce the students to various concepts like dimensioning, conventions and standards of engineering drawings in order to become professionally efficient
2. To enable students to learn about the software tool to prepare engineering drawings
3. To teach the students about the concepts and principles of orthographic projections, development of lateral surfaces and isometric projection of simple solids
4. To communicate the concept/idea with others through the language of technical drawing and sketching.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Construct the simple 2D drawings manually and also by using CAD software	1,5,10,12	1
CO2	Draw orthographic projection of point, line, plane surfaces and simple solids	1,3,5,10, 12	1
CO3	Draw sectional views of a prisms, pyramids, cone and cylinder	1,3,5,10, 12	1

CO4	Develop the lateral surfaces of the solids	1-3,5,10,	1,2,3
CO5	Create isometric view of the solids	1,3,5,10, 12	1
CO6	Develop solutions in the CAD to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	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

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3				3					3		2	3		
CO2	3		2		3					3		2	3		
CO3	3		2		3					3		2	3		
CO4	3	2	2		3					3		3	3	3	2
CO5	3		2		3					3		3	3	2	1
CO6					2				2	2				2	2

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

COURSE CONTENT
THEORY:

CONTENTS

UNIT – 1
Introduction – Geometrical constructions, engineering drawing standards, Introduction to CAD Software. Orthographic projection of points in first and third Quadrant only. Orthographic projection of straight lines inclined to both horizontal and vertical planes. Orthographic projection of regular plane surfaces when the surface is inclined to both HP and VP.
UNIT-2
Orthographic projection of regular solids like prisms, pyramids cone and cylinder when the axis is inclined to both HP and VP.
UNIT-3
Sections of solids – Drawing sectional views and true shape of section, Development of surfaces- Parallel line method for prisms and cylinders, Radial line method for pyramids and cones.
UNIT-4
Isometric projections of simple and combined solids.

PRACTICE:

No	Practice	Tools and Techniques	Expected Skill /Ability
1.	Use of solid edge software and familiarization of tools	Solid Edge Software	Use of commands to draw the drawings
2.	Draw the projection of point locating in first and third quadrant	Solid Edge Software	Analyzing and software skill
3.	Draw the projection of lines locating in first quadrant	Solid Edge Software	Draw the views of the line and software skill
4.	Draw the projection of rectangular and pentagonal lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
5.	Draw the projection of hexagonal and circular lamina inclined to both HP and VP	Solid Edge Software	analyzing and software skill
6.	Draw the projection of prisms inclined to both HP and VP	Solid Edge Software	interpretation and software skill
7.	Draw the projection of pyramids inclined to both HP and VP	Solid Edge Software	interpretation and software skill
8.	Draw the projection of cone and cylinder inclined to both HP and VP	Solid Edge Software	interpretation and software skill
9	Draw the projection of section of solids in simple position	Solid Edge Software	analyzing and software skill
10	Develop the lateral surface of prisms and cylinder	Solid Edge Software	Creative and software skill
11	Develop the lateral surface of pyramids and cone	Solid Edge Software	Creative and software skill
12	Draw the isometric projection of simple plane surface and simple solids	Solid Edge Software	Analyzing and software skill
13	Draw the isometric projection of two co-axial solids	Solid Edge Software	Analyzing and software skill

TEXT BOOKS:

1. K. R. Gopalakrishna, “Engineering Graphics”, Subhas Publications, 2012.
2 Bhatt N.D., Panchal V.M. & Ingle P.R., “Engineering Drawing”, CharotarPublishing House,2014.

REFERENCE BOOKS:

1. Luzadder and Duff, "Fundamental of Engineering Drawing", Prentice hall of India Pvt Ltd. 11th Edition, 2001.
2. Shah, M.B. & Rana B.C., "Engineering Drawing and Computer Graphics", Pearson Education,2008.

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/112/103/112103019/
2. https://www.udemy.com/course/ed/

PROBLEM BASEDLEARNING

Sl. No	Problems
1	A point 30 mm above XY line is the front view of two points A and B. The top view of A is 40 mm behind VP and the top view of B is 45 mm in front of VP. Draw the projections of the points and state the Quadrants in which the points are situated.
2	A point 'A' is 30 mm in front of VP & 40 mm above HP. Another point B is 20 mm behind VP & 35 mm below HP. The horizontal distance between the points measured parallel to XY line is 60 mm. Draw the three projections of the points. Join their front and top views.
3	A point P is on HP and 35 mm in front of VP. Another point Q is on VP and below HP. The line joining their front views makes an angle of 300 to XY line, while the line joining their top views makes an angle of 450 with XY line. Find the distance of the point Q from HP.
4	A point is 35 mm below HP, 20 mm behind VP and 25 mm behind / in front / from RPP. Draw its projections and name the side view.
5	A line AB 80 mm long is inclined to HP at 30 degree and inclined to VP at 45degree. Draw front and top views of line and determine their lengths. Also, measure the perpendicular distance of end B from both HP & VP.
6	A line AB has its end A 20 mm above the HP and 30 mm in front of VP. The other end B is 60 mm above HP and 45 mm in front of VP. The distance between end projectors is 70 mm. draw its true length and apparent inclinations.
7	The top view pq of a straight line is 70 mm and makes an angle of 60 degree with XY line. The end Q is 10 mm in front of VP and 30 mm above HP. The difference between the distances of P and Q above HP is 45 mm. draw the projections. Determine its true length and true inclinations with HP
8	The top view of a line 75 mm long measures 50 mm. The end P is 30 mm in front of VP and 15 mm above HP. The end Q is 15 mm in front of VP and above HP. Draw the projections of the line and find its true inclinations with HP and VP.
9	The distance between the end projectors through the end points of a line AB is 60 mm. the end A is 10 mm above HP and 15 mm in front of VP. The end B is 35 mm in front of VP. The line AB appears 70 mm long in the front view. Complete the projections. Find the true length of the line and its inclinations with HP and VP.
10	The point B of a line AB is on the horizontal plane, the top view of the line makes an angle of 30 degree with XY line, being 80mm. the point A is on the vertical plane and 50 mm above the horizontal plane. Draw the top and front views of the line and obtain the true length of the line. Also find the inclinations of the line with two planes.
11	The end A of a line AB is in HP and 25 mm in front of VP. The end B is 10 mm in front of VP and 50 mm above HP. The distance between the end projectors when measured parallel to the line of intersection of HP and VP is 80 mm, Draw the projection of the line AB and determine its true length and true inclination with HP and VP.

Sl. No	Problems
12	Find the true length and true inclination of a line AB with HP having one of its ends 20 mm in front of VP and 30 mm above the HP. The line is inclined at 40 degree to VP and left side view of the line is 60 mm long and inclined at 60degree to the x1y1 line. Draw all the three views of the line.
13	An equilateral triangular lamina of 25mm side lies with one of its edges on HP such that the surface of the lamina is inclined to HP at 60degree. The edge on which it rests is inclined to VP at 60degree.
14	A 30 degree-60degree setsquare of 60mm longest side is kept such that the longest side is in HP, making an angle of 30 degree with VP. The set square itself is inclined at 450 to HP. Draw the projections of the setsquare.
15	A square lamina ABCD of 40mm side rests on corner C such that the diagonal AC appears to be at 45 degree to VP. The two sides BC and CD containing the corner C make equal inclinations with HP. The surface of the lamina makes 30 degree with HP. Draw its top and front views.
16	A mirror 30 mm x 40 mm is inclined to the wall such that its front view is a square of 30 mm side. The Longer sides of the mirror appear perpendicular to both HP and VP. Find the inclination of the mirror with the wall.
17	A pentagonal lamina of sides 25 mm is resting on one of its edges on HP with the corner opposite to that edge touching VP. This edge is parallel to VP and the corner, which touches VP, is at a height of 15 mm above HP. Draw the projections of the lamina and determines the inclinations of the lamina with HP and VP and the distance at which the parallel edge lies from VP.
18	A pentagonal lamina of sides 25 mm is having a side both on HP and VP. The corner opposite to the side on which it rests is 15 mm above HP. Draw the top and front views of the lamina.
19	Draw the top and front views of a hexagonal lamina of 30mm sides having two of its edges parallel to both vertical and horizontal planes and one of its edges is 10 mm from each of the planes of projection. The surface of the lamina is inclined at an angle of 60° to the HP.
20	A hexagonal lamina of sides 30 mm has one of its comers in VP and its surface inclined at an angle of 30° with VP. The diagonal passing through that corner which is in VP appears to be inclined at 45° to HP. Draw the projections of the lamina.
21	A hexagonal lamina of sides 25 mm rests on one of its corners on HP. The corner opposite to the corner on which it rests is 35mm above HP and the diagonal passing through the corner on which it rests is inclined at 30° to VP. Draw its projections. Find the inclination of the surface with HP.
22	Draw the projections of a circular plate of negligible thickness of 50 mm diameter resting on HP on a point A on the circumference, with its plane inclined at 45° to HP and the top view of the diameter passing through the resting point makes 60° with VP.
23	A circular lamina inclined VP appears in the front view as an ellipse of major axis 30 mm and minor axis 15 mm. The Major- axis is parallel to both HP and VP. One end of the minor axis is in both the HP and VP. Draw the projections of the lamina and determine the inclination of the lamina with the VP.
24	A square prism 35mm side of base & 60mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º. Draw the projections of the prism when the axis is inclined to HP at
25	A pentagonal prism 25mm sides of base & 60mm axis length rests on HP on one of its edges of the base. Draw the projections of the prism when the axis is inclined to HP at 40° & VP at 30º
26	A Hexagonal prism 25mm sides of base and 50mm axis length rests on HP on one of its edges. Draw the projections of the prism when the axis is inclined to HP at 45° & appears to be inclined to VP
27	A cone 40 mm diameter and 50 mm axis is resting on one generator on HP which makes 30º inclination with VP. Draw its projections.
28	A pentagonal pyramid 25mm sides of base and 50mm axis length rests on HP on one of its edges of the base which is inclined to VP at 30º.Draw the projections of the pyramid when the axis is inclined to HP at 45º
29	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.

Sl. No	Problems
30	A vertical cylinder of base diameter 50 mm and axis 65 mm long rests on HP. It is cut by a section plane perpendicular to VP, inclined at 45 degree to HP and at a height of 30mm from the base. Draw its sectional top view and true shape of the section.
31	A hexagonal pyramid 30mm sides of base and axis 70mm long is resting on its base on HP with one of the edges of the base parallel to VP. It is cut by sectional plane, perpendicular to VP, inclined at 30° to HP and bisects the axis. Draw the front view, sectional top view & true shape of the section.
32	A square pyramid base 40mm side and axis 65mm long has its base on HP and all the edges of the base are equally inclined to VP. It is cut to with an inclined plane so as the truncated surface at 45 degree to axis, bisecting it. Draw the development of the truncated pyramid.
33	A Hexagonal prism of base side 30mm and axis length 60mm resting on HP in such a way that two of its edges are parallel to VP. The prism is cut by a section plane which is perpendicular to the VP and inclined at 30º to the HP at a height of 35mm from the base. Draw the development of the lateral surface of the prism.
34	A pentagonal prism, 30 mm base side & 50 mm axis is standing on HP on its base whose one side is perpendicular to VP. It is cut by a section plane 45 degree inclined to HP, through mid-point of axis. Draw FV, sectional top view& sec. Side view. Also draw true shape of section and Development of surface of remaining solid.
35	A hexagonal pyramid 25mm side of base and axis 65mm long is resting on its base on HP with one of the edged of the base parallel to VP. It is cut by a section plane inclined at 60º to HP and perpendicular to VP and intersecting the axis at 30mm above the base. Draw the development of the remaining portion of the pyramid.
36	A cone of base diameter 40 mm and height 50 mm is placed centrally on the top of a square slab side 60 mm and height 25 mm. Draw the isometric projection of the combination.
37	A sphere of diameter 45mm rests centrally over a frustum of cone of base diameter 60mm,top diameter 40mm and height 50mm.Draw its isometric projections.
38	A cube of 35 mm placed centrally on a square slab of 50 mm and thickness 30 mm. Draw the isometric projection of the combination.
39	Draw the isometric projection of the combination. Draw isometric projection of a hexagonal prism of side of base 40mm and height 60mm with a right circular cone of base 40mm as diameter and altitude 50mm, resting on its top such that the axes of both the solids are collinear.
40	A rectangular pyramid of base 40mmx25mm and height 50mm is placed centrally on a rectangular slab side 100mmx60mm and thickness 20mm.Draw the isometric projection of the combination.

PROJECTBASEDLEARNING

To enhance the skill-set in the integrated course, the students are advised to execute course-based design projects. Some sample projects are given below:

No.	Suggested Projects
1.	Model making of different solids by using Hardbound sheet.
2.	Using Hardbound sheet, prepare the different solids models by development and section methods.
3.	Prepare a demo model to show the principle of orthographic projection.
4.	Prepare the models for showing the method of Isometric projection.
5.	Problem based on Practical approach in view of orthographic projection of lines and planes.
6.	Collection or Interpretation of Engineering Drawing sheets Related to Manufacturing, Civil construction, Layouts, Plans and other Applications.
7.	Study on Comparison of 3D views and isometric Views.
8.	Drawing the Plan of students Home or building (2D)

Detailed Syllabus
Semester 2

<table>
<tr><td>Course Title</td><td colspan="4">Probability and Statistics</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>CourseCode</td><td>B20AS0204</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>Tutorial</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>4</td><td>4</td><td>52</td><td>-</td><td>50%</td><td>50%</td></tr>
</table>

COURSE OVERVIEW:

The course Probability and Statistics for Computer Science treats the most common discrete and continuous distributions, showing how they find use in decision and estimation problems, and constructs computer algorithms for generating observations from the various distributions. Probability in the design and analysis of randomized algorithms. Common randomized algorithms are things like Quick sort and Quick select. Probabilistic method can also useful to prove various important results. Probabilistic methods used to prove some partition theorems that were then used to create efficient data structure.

COURSE COBJECTIVE (S):

The objectives of this course are to:

1. Describe Curve fitting and regression in various problems in Computer Science & engineering fields
2. Illustrate the applications of Probability and statistics in various computer science engineering Fields like data mining, classification problems etc.
3. Discuss Sampling theory concepts to solve various engineering problems likestructured and unstructured Data models
4. Demonstrate Stochastic problem as Markov model as a problem solving methodsfor systematic model buildings.
5. Learn new algorithms and methods in probability and statistics and apply for suitable problem solving methods.
6. Create solutions for problem solving methods using algorithms to the complex problems, either individually Or as a part of the team and report the results with proper analysis.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Solve the problems of Curve fitting and regression in various problems in Computer Science & Engineering fields.	1-6	1,2
CO2	Apply the concepts of Probability and statistics in various computer science engineering fields like data mining, classification problems etc.	1-6	1,2
CO3	Develop a stochastic problem as Markov model as a problem solving methods for systematic model buildings.	1-6	1,2
CO4	Make use of sampling theory concepts to solve various engineering problems like structured and unstructured data models.	1-6	1,2
CO5	Learn new algorithms and methods in probability and statistics and apply for suitable problem solving methods.	1-6	1,2
CO6	Create solutions for problem solving methods using algorithms to the complex problems, either individually or as a part of the team and report the results with proper analysis.	1-5,9	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓		✓	
CO3			✓			
C04			✓	✓		
C05		✓				
C06			✓			

COURSE ARTICULATION MATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	3	1							3	3
CO2	3	3	3	3	3	1							3	3
CO3	3	3	2	2	2	1							2	2
CO4	2	3	2	2	3	1							1	1
CO5	3	3	2	2	1	1							2	1

CO6	2	3	3	3	1	1							2	1

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

COURSE CONTENT

THEORY

Contents
UNIT – 1
Curve Fitting:Curve fitting by the method of least squares and fitting of the curves of the form, *y = ax + b, y = ax2 + bx + c, y = aebx and y = axb* Statistical Methods: Measures of central tendency and dispersion. Correlation-Karl Pearson's coefficient of correlation-problems. Regression analysis- lines of regression, problems. Rank correlation. Applications in computer science
UNIT – 2
Probability distributions: Recap of probability theory (definition, addition rule, multiplication rule, conditional probability). Random variables, Discrete and continuous probability distributions. Binomial, Poisson, exponential and normal distributions (derivation of mean and variance for all distributions). Applications in computer science.
UNIT – 3
Joint Probability distribution: Joint Probability distribution for two discrete random variables (both discrete and continuous cases), expectation, covariance, correlation coefficient. Stochastic processes- Stochastic processes, probability vector, stochastic matrices, fixed points, regular
UNIT – 4
Sampling theory:-Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. Applications in Computer Science.

TEXTBOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. ErwinKreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.
3. Seymour Lipschutz, John J. Schiller., "Schaum's Outline of Introduction to Probability and Statistics" McGraw Hill Professional, 1998, pp. 256.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19thprint edition, 2013.
2. R.K.Jain and S.R.K.Iyengar, "Advanced Engineering Mathematics", Narosa PublishingHouse, 4th edition, 2016.
3. V.Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 2009
4. Dr. B. Krishna Gandhi, Dr. T.K.V. Iyengar, Dr. M.V.S.S.N. Prasad&S. Ranganatham."Probability and Statistics", S. Chand Publishing, 2015.
5. J. K. Sharma "Operations Research theory and applications", Macmillan publishers, fifth

JOURNALS/MAGAZINES

1. https://www.hindawi.com/journals/jps/
2. https://www.journals.elsevier.com/statistics-and-probability-letters
3. http://www.isoss.net/japs/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/browse/data-science/probability-and-statistics\
2. https://nptel.ac.in/courses/111/105/111105041/
3. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

SELF-LEARNINGEXERCISES:

1. Curve fitting for application problems, Regression analysis for a bivariate data.
2. Probability distribution- Geometric, gamma- distributions, Joint probability distributions of

continuousrandomvariables.

3. Sampling analysis of real time problems. Applications to computer science: Data Mining, classification problems etc.

<table>
<tr><td>Course Title</td><td colspan="4">Physics for Computer Science</td><td colspan="2">Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>B20AS0106</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">IA</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course introduces the basic concepts of Physics and its applications to Computer Science Engineering courses by emphasizing the concepts underlying four UNITs: Wave Mechanics, Lasers and optical fibers, EM wave and spectrum, Display Technology and Quantum computation. The subject has basic laws, expressions and theories which help to increase the scientific knowledge to analyze upcoming technologies.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Impart the knowledge about wave mechanics, electromagnetic waves, and its applications

2.Demonstrate the different applications of lasers, and optical fibers

3.Discuss different types of display technologies, touch screen techniques and its applications

4.Explain the importance of quantum computation as an emerging technology.

5. Learn new tools and technologies Physics and its applications to Computer Science Engineering and

Applyfor suitable technologies.

6.Increase the scientific knowledge to analyze upcoming technologies.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply knowledge of wave mechanics, its importance, and applications	1-4	1
CO2	Classify EM waves based on the frequency range, optical fibers and derive expression for NA, number of Modes and attenuation.	1-4	1
CO3	Summarize capacitive and resistive Display Technologies.	1-4	2
CO4	Analyze the working and application of quantum computation	1-3	1

CO5	Learn new tools and technologies Physics and its applications to Computer Science Engineering and apply for suitable technologies.	1-4	2
CO6	Increase the scientific knowledge to analyze upcoming technologies.	1-3	1

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	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1									3		
CO2	3	3	2	1									3		
CO3	3	3	2	1										3	
CO4	3	2	1										3		
CO5	3	2	2										3		
CO6	3	2	2										3		

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Wave mechanics: Introduction to Wave mechanics, De-Broglie hypothesis. Expression for de-Broglie wavelength of an electron in terms of accelerating potential. Phase velocity and group velocity, Relation between phase velocity and group velocity. Quantum Physics: Wave function, properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time- dependent and independent wave equation, Eigen values and Eigen functions. Applications of Schrödinger wave equation – energy Eigen values of a free particle, Particle in one dimensional infinite potential well with numerical examples. Application-Quantum computation.

UNIT-2
Lasers: Lasers Interaction between radiation and matter (induced absorption, spontaneous and stimulated emission). Expression for energy density at thermal equilibrium in terms of Einstein's coefficients. Characteristics of laser light, Conditions for laser operation (population inversion and Meta stable state). Requisites of laser system, semiconductor laser and its applications. Electromagnetic Waves: Basic idea of displacement current, Electromagnetic waves, their characteristics, Electromagnetic spectrum (7 types of EM waves) including elementary facts. Uses of EM waves in communications.
UNIT-3
Optical fibers: Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Acceptance angle, Numerical Aperture (NA), Expression for numerical aperture in terms of core and cladding refractive indices, Condition for wave propagation in optical fiber, V-number and Modes of propagation, Types of optical fibers, Attenuation and reasons for attenuation, Applications: Explanation of optical fiber communication using block diagram, Optical source (LED) and detector (Photodiode) and their applications. Advantages and limitations of optical communications.
UNIT-4
Display technology: Touch screen technologies: Resistive and capacitive touch screen and Displays: CRT, Field emission display, Plasma display, LED display, OLED display, LCD display. Quantum Computation: Quantum wires (one dimensional), Quantum dots (zero dimensional); the idea of "qubit" and examples of single qubit logic gates- Classical bits, Qubit as a two-level system.

TEXT BOOKS:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University press, New York, 2004
2. D. Halliday, R. Resnick and J. Walker, "Fundamentals of Physics", John Wiley and Sons, New York, 10th edition 2013
3. R. K. Gaur and S.L. Gupta, "Engineering Physics", DhanpatRai Publications (P) Ltd, New Delhi. 53rd edition, 2014.
4. M.N. Avadhanulu and P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand and Company, New Delhi, 2014.
5. EM Waves and Fields: P. Lorrain and O. Corson.

REFERENCE BOOKS:

1. CharlsKittel, "Introduction to Solid State Physics", Wiley, Delhi,8th Edition, 2004
2. Arthur Beiser, "Concepts of modern Physics", Tata McGraw Hill publications, New Delhi, 8th Edition, 2011.
3. S. O. Pillai, "Solid State Physics", New Age International publishers, New Delhi, 2010
4. Chen, Wayne Cranton, Mark Fihn, "Handbook of Visual Display Technology", Springer Publication, Secondedition 2012.

JOURNALS/MAGAZINE

1. https://www.codemag.com/Magazine/ByCategory/Python
2. http://ijaerd.com/papers/special_papers/IT032.pdf
3. https://iopscience.iop.org/article/10.1088/1742-6596 / 423 / 1 / 012027
4. https://ieeexplore.ieee.org/document/4160250
5. Python for scientific computing

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc.org/
2. https://www.coursera.org/

Course Title	Introduction to Data Science				Course Type		Integrated	
Course Code	B20CS0101	Credits	3		Class		II semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	1	2	2	Theory	Practical	IA	SEE
	Tutorial	-	-	-				
	Total	**3**	**4**	**4**	**26**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Data Science is an interdisciplinary, problem-solving oriented subject that is used to apply scientific techniques to practical problems. The course orients on preparation of datasets and programming of data analysis tasks. This course covers the topics: Set Theory, Probability theory, Tools for data science, ML algorithms and demonstration of experiments by using MS-Excel.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of Excel.
2. Illustrate the use of basic concepts of Data Science in the real world applications.
3. Demonstrate the use of SQL commands in real world applications.
4. Discuss the functional components of Data Science for real world applications

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the concepts of Data Science in developing the real world applications.	1-4,11	1,2
CO2	Apply the SQL commands in developing the real-world applications.	1,2	2, 3
CO3	Build the data analytics solutions for real world problems, perform analysis, interpretation and reporting of data.	1-4	1, 2, 3
C04	Create the real world AI based solutions using different machine learning algorithms	1-4	1, 2
C05	Learn new tools and technologies in Data Science and apply for suitable application development.	1-5	1,2
C06	Develop solutions in the Data Science to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation	1-3	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom's Level					
	Remember(L1)	Understand(L2)	Apply(L3)	Analyze(L4)	Evaluate(L5)	Create(L6)
CO1			✓			
CO2			✓			
CO3			✓	✓		
C04			✓	✓	✓	✓
C05		✓	✓			
C06			✓	✓		

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2							3	3	3	3	
CO2	2	2									2	2		3	3
CO3	3	3	3	3							3	3	3	3	2
C04	3	3	3	3							3	3	3	3	
C05	3	3	3	3									3	3	
C06	3	3	3	1									3	3	2

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction to Microsoft Excel Creating Excel tables, understand how to Add, Subtract, Multiply, Divide in Excel. Excel Data Validation, Filters, Grouping. Introduction to formulas and functions in Excel. Logical functions (operators) and conditions. Visualizing data using charts in Excel. Import XML Data into Excel How to Import CSV Data (Text) into Excel, How to Import MS Access Data into Excel, Working with Multiple Worksheets.
UNIT-2
Introduction to Data Science What is Data Science? Probability theory, Bayes theorem, Bayes probability; Cartesian plane, equations of lines, graphs; exponents. **Introduction to SQL** SQL: creation, insertion, deletion, retrieval of Tables by experimental demonstrations. Import SQL Database Data
UNIT-3
Data science components Tools for data science, definition of AI, types of machine learning (ML), list of ML algorithms for classification, clustering, and feature selection. Description of linear regression and Logistic Regression. Introducing the Gaussian, Introduction to Standardization, Standard Normal Probability Distribution in Excel, Calculating Probabilities from Z-scores, Central Limit Theorem, Algebra with Gaussians, Markowitz Portfolio Optimization, Standardizing x and y Coordinates for Linear Regression, Standardization Simplifies Linear Regression, Modeling Error in Linear Regression, Information Gain from Linear Regression.
UNIT-4
Data visualizationusing scatter plots, charts, graphs, histograms and maps Statistical Analysis: Descriptive statistics- Mean, Standard Deviation for Continuous Data, Frequency, Percentage for Categorical Data **Applications of Data Science** Data science life cycle, Applications of data science with demonstration of experiments either by using Microsoft Excel.

PRACTICE:

<table>
<tr><th>No</th><th>Title of the Experiment</th><th>Tools and Techniques</th><th>Expected Skill/Ability</th></tr>
<tr><td>1</td><td>The height (in cm) of a group of fathers and sons are given below, Find the lines of regression and estimate the height of son when the height of father is 164 cm.

Plot the graph.
Hgt of Fathers
Hgt of Sons

15 16 16 16 16 17 16 17 17 18
8 6 3 5 7 0 7 2 7 1
16 15 16 17 16 18 17 17 17 17
3 8 7 0 0 0 0 5 2 5</td><td>MS Excel</td><td>Create and perform operations on Excel data set by applying Linear regression</td></tr>
<tr><td>2</td><td>Using the data file DISPOSABLE INCOME AND VEHICLE SALES, perform the following:
Plot a scatter diagram.
Determine the regression equation.
Plot the regression line (hint: use MS Excel's Add Trend line feature).
Compute the predicted vehicle sales for disposable income of $16,500 and of $17,900.
Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>3</td><td>Managers model costs in order to make predictions. The cost data in the data file INDIRECT COSTS AND MACHINE HOURS show the indirect manufacturing costs of an ice-skate manufacturer. Indirect manufacturing costs include maintenance costs and setup costs. Indirect manufacturing costs depend on the number of hours the machines are used, called machine hours. Based on the data for January to December, perform the following operations.
Plot a scatter diagram.
Determine the regression equation.
Plot the regression line (hint: use MS Excel's Add Trend line feature).
Compute the predicted indirect manufacturing costs for 300 machine hours and for 430 machine hours.
Compute the coefficient of determination and the coefficient of correlation</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>4</td><td>Apply multiple linear regression to predict the stock index price which is

year | month | interest rate | unemployment rate | stock index price
2020 | 10 | 2.75 | 5.3 | 1464</td><td>MS Excel</td><td>Perform prediction and visualization of data</td></tr>
<tr><td>5.</td><td>Calculate the total interest paid on a car loan which has been availed from HDFC bank. For example, Rs.10, 00,000 has been borrowed from a bank with annual interest rate of 5.2% and the customer needs to pay every month as shown in table below. Calculate the total interest rate paid for a loan availed of Rs.10, 00,000 during 3 years.

Sl No. | A | B
1 | Principal | Rs.10,00,000
2 | Annual interest rate | 5.20%
3 | Year of the loan | 3
4 | Starting payment number | 1
5 | Ending payment number | 36
6 | total interest paid during period | ?</td><td>MS Excel</td><td>Create Excel data and perform EMI estimator</td></tr>
</table>

6	Create a supplier database of 10 records with SUPPLIER_ID as primary key, SUPPLIER_NAME, PRODUCTS, QUANTITY, ADDRESS, CITY, PHONE_NO and PINCODE, Where SUPPLIER_NAME, PRODUCTS, QUANTITY and PHONE_NO, should not be NULL.	SQL	Creating Tables
7	Create the customer database of a big Market with CUSTOMER_ID as primary key, CUSTOMER_NAME, PHONE_NO, EMAIL_ID, ADDRESS, CITY and PIN_CODE. Store at least twenty customer's details where CUSTOMER_NAME and PHONE_NO are mandatory and display the customer data in alphabetical order.	SQL	Creating and retrieving Tables
8	Apply linear regression to find the weather (temperature) of a city with the amount of rain in centimeters. Create your own database with following details. CITY Temperature in Centigrade Rain in Centimeters	MS Excel	Apply Linear regression
9	Use the linear regression technique to compare the age of humans with the amount of sleep in hours. Name Age in Years Sleep in hours Create your own database with above details.	MS Excel	Apply Linear regression
10	Apply the linear regression, compare the average salaries of batsman depending on the run rate scored/ recorded in the matches. Assume your own database.	MS Excel	Apply Linear regression
11	Design the ER diagram and create schema of the REVA library management system.	Entity Relationship	Entity Relationship
12	Design the ER diagram and create schema for Hospital Management system.	Entity Relationship	Schema design

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43nd edition, 2015.
2. Ramakrishnan and Gehrke, "Database Management systems", Third Edition, McGraw HillPublications,2003.
3. Mastering Data Analysis in Excel - https://www.coursera.org/learn/analytics-excel.
4. Kenneth N. Berk, Carey, "Data Analysis with Microsoft Excel", S. Chand & Company, 2004.

REFERENCE BOOKS:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 19th edition, 2013.
2. ErwinKreyszig, "Advanced Engineering Mathematics", Wiley Publications, 9th edition, 2013.
3. Seymour Lipschutz, John J. Schiller, "Schaum's Outline of Introduction to Probability and Statistics",McGraw Hill Professional, 1998.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/computational-statistics-and-data-analysis
2. https://www.springer.com/journal/41060- International Journal on Data Science and Analytics
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=8254253-IEEE Magazine on Big data &Analytics

SWAYAM/NPTEL/MOOCs:

1. Excel Skills for Business: Essentials, Macquarie University (https://www.coursera.org/learn/excel-Essentials)
2. SQL for Data Science, University of California, Davis (https://www.coursera.org/learn/sql-for-data-science)
3. Data Science Math Skills, Duke University (https://www.coursera.org/learn/datasciencemathskills)
4. https://www.edx.org/course/subject/data-science
5. https://onlinecourses.nptel.ac.in/noc19_cs60/preview

SELF-LEARNINGEXERCISES:

1. Relational database management system.

2. Advanced MS-Excel

Course Title	Basics of Civil and Mechanical Engineering				Course Type		Integrated	
Course Code	B20CE0201	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2				
	-	-	-	-	Theory	Practical	IA	SEE
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

This course introduces the Mechanical and Civil Engineering concepts, underlying the fact that this knowledge is essential for all Engineers. The students are made to understand the concept of internal combustion engines and power transmission systems. The students are also exposed to the knowledge of mechanical machine tools with its operations on lathe, drilling, and CNC machines. The students are introduced to the domain of fabrication processes like Soldering, Welding and 3D printing technology. Along with this student are made to expose to scope of Civil engineering, role of civil engineers in different infrastructure & economic development of the country. Students will learn about basic concept of forces, friction, centroid and moment of inertia.

COURSE OBJECTIVE

This course enables graduatingstudents

1. To develop the basic knowledge of IC engines, refrigeration-air conditioning and power Transmission systems.
2. To incorporate the concepts of manufacturing processes using different machine tools, welding Techniques, CNC and 3D printing technology.
3. To understand a broad concept of engineering mechanics.
4. To develop the basics of composition of coplanar forces and fluid mechanics
5. Learn concept of internal combustion engines and power transmission systems
6. Introduction to the domain of fabrication processes like Soldering, Welding and 3D printing technology.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the fundamentals of IC engines, refrigeration-air conditioning and power transmission systems.	1,2	3
CO2	Explain the manufacturing processes using lathe, drilling, welding, CNC machines and 3D printing technology	1,2	3
CO3	Describe the moment of force and couples and equivalent force-couple system.	1,2	3
CO4	Solve numerical problems on composition of coplanar concurrent and non-concurrent force system and basics of fluid mechanics	1,2	3
CO5	Learn concept of internal combustion engines and power transmission systems	1,2	1

CO6	Introduction to the domain of fabrication processes like Soldering, Welding and 3D printing technology.	1,5	1

BLOOM'S LEVELOF THECOURSE OUTCOMES

CO#	Bloom'sLevel					
	Remember (L1)	Understand (L2)	Apply (L3)	Analyze (L4)	Evaluate (L5)	Create (L6)
CO1		✓				
CO2		✓				
CO3	✓	✓	✓	✓	✓	
C04	✓	✓	✓			
C05		✓				
C06		✓				

COURSE ARTICULATIONMATRIX

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2													1
CO2	3	2													1
CO3	3	2													1
C04	3	2													1
C05	3	2													1
C06	3	2													1

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Introduction to Mechanical Engineering: Overview of Mechanical Engineering, Importance and applications of Mechanical Engineering in different fields. Thermal Energy Systems: Introduction to IC Engines, Classification, parts of IC Engine, working of 4-stroke Petrol engine with PV-diagram. Simple numerical on calculation of IP, BP and Mechanical efficiency, Introduction to refrigeration system, working of vapour compression refrigeration and window spit air conditioning system. Applications of refrigeration systems
UNIT-2
Power Transmission System: Introduction to drives, classification, belt drives (open and crossed-No derivations) and gear drives and types of gear, Numerical on gear drives. Mechanical Machine Tools: Introduction- lathe, classification, major parts of engine lathe, operations, Drilling machine, classification working bench drilling machine and operations, CNC Machines-Block diagram and applications. Introduction to 3D Printing technology Joining processes-Welding: Working of electric arc welding and soldering, Differences between welding and
UNIT-3
Introduction to Civil Engineering: Scope of Civil Engineering, Types of Infrastructure, Effect of Infrastructure facilities, Role of Civil Engineers in the Infrastructure and Economic Development of Country. Introduction to Engineering Mechanics: Basic concepts, Newton laws of Motion Elements of force, system of forces, principles of physical Independence, superposition and Transmissibility of forces. Moment of force –Couple, Moment of couple and its characteristics, Equivalent Force – Couple system. Resolution and composition of forces. Coplanar Concurrent Force System: Parallelogram Law of forces, principle of resolved parts, composition of
UNIT-4
Coplanar Non – concurrent forces: Varignon's principle of Moments, Resultant of Non – Concurrent force systems, Equilibrium of Coplanar Concurrent Force System: Type's forces acting on the body, free body diagrams, Equations of Equilibrium, Lami's theorem, Equilibrium of Non – concurrent forces equilibrium equations Friction: Frictional forces, Law of friction, Angle of friction, Angle of Repose and Cone of Friction (Theory only) Centroid: Center of Gravity, Center of Gravity of Flat Plate, Centroid, difference between Center of gravity and Centroid, Uses of Axis Symmetry, simple problems Moment of Inertia: Moment of Inertia of Plane Figure, Polar Moment of Inertia and Moment of Inertia of Standard sections (Derivations not included). Simple problems. Fluid Mechanics: Introduction, methods of describing fluid motion, definitions of types of fluid flow, streamline, path line, stream tube. General Continuity equation (problems).

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Dismantling and Assembly of 2-Wheeler (2–stroke) Engine	2-Stroke Engine (TVS Bike)	Hands on Experience
2	Study of Fitting tools and preparation of fitting model (1 Model)	Fitting tools	Hands on experience
3.	Study of sheet metal tools and development of Cylinder (1 Model)	Sheet metal tools and soldering tools	Hands on experience
4.	Study of sheet metal tools and development of Pen stand and funnel (2-Models)	Sheet metal tools and soldering tools	Creative Thinking
5.	Hands on training on basic welding joint (Butt Joint-1 Model)	Welding tools	Hands on experience
6.	To study the carpentry tools with one model (Half joint-Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
7.	To study the carpentry tools with one model (Dovetail-Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
8.	To study the carpentry tools with one model (T-Joint - Model)	Carpentry Tools (Marking, Sawing, Planning and Chiseling	Comprehend the different handling carpentry tools
9.	To Study the plumbing tools and to make threads on pipe and pipe fittings using plumbing tools	Plumbing Tools	Comprehend the different handling plumbing tools
10.	To Study the plumbing tools used for valves and sanitary fitting	Plumbing Tools	Comprehend the different handling plumbing tools

TEXTBOOKS:

1. K.R. Gopalkrishna ,“Elements of Mechanical Engineering”, 12th Edition, Subhash Publishers, Bengaluru, 2012.
2. Roy & Choudhury, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd, Mumbai, 2000.
3. Mikell P Groover : Automation, Production Systems, and Computer Integrated Manufacturing , Pearson India, 2007, 4th Edition

REFERENCE BOOKS:

1. SKH Chowdhary, AKH Chowdhary, Nirjhar Roy,”The Elements of Workshop Technology Vol I & II, 11th edition, Media Promotors and publisher, Mumbai, 2001.
2. AvikshitSaras, “3D Printing-Made Simple”, BPB Publications-New Delhi.

JOURNALS/MAGAZINES

1. International Journal of Machine Tools and Manufacture
2. International Journal of Refrigeration.

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/103/112103262/#
2. https://www.my-mooc.com/en/mooc/fundamentals-manufacturing-processes-mitx-2008x/
3. https://www.coursera.org/learn/3d-printing-applications

Course Title	Programming for Problem Solving				Course Type		Integrated	
Course Code	B20CS0102	Credits	4		Class		IISemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	IA	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Algorithms and flowcharts are the fundamental tools for problem solving which can be used by the computers. The computer programs can be developed using algorithms and flowcharts to provide solutions to problems. C Language is a general-purpose, structured and procedure oriented programming language. It is one of the most popular computer languages today because of its structure and higher-level abstraction C. This course introduces algorithms, flowcharts and various C Programming language constructs for the development of real world applications.

COURSE OBJECTIVE (S):

1. Explain algorithms, flowcharts and different programming constructs of C to be used for Developmentof applications.
2. Illustrate the use of iterative statements and conditional Statements for solving the real world problems.
3. Demonstrate the use of functions with parameter passing mechanisms for solving the real world problems.
4. Discuss the use of structures, unions, pointers and file operations for solving the real world Problems.
5. Learn new algorithms and technologies in C Programming and apply for suitable application development.
6. Develop solutions by using C Programming to the complex problems, either individually or as a part of teamand report the results.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the programming constructs of C language to solve a given problem.	1-6	1
CO2	Apply the concepts of matrices to develop data processing and analysis solutions in various application domains.	1-5	1
CO3	Develop text processing based applications using string operations.	1-5	2,3
CO4	Create solutions for real world problems using Pointers, Union, Structures and file operations.	1-5	2,3
CO5	Learn new algorithms and technologies in C Programming and apply for suitable application development	1-5	2,3
CO6	Develop solutions by using C Programming to the complex problems, either individually or as a part of the team and report the results	1-5,9	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

CO#/ Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	1	2	1							3		
CO2	1	3	2	2	1								3		
CO3	2	2	2	2	1									3	3
CO4	3	3	3	1	1									3	3
CO5	3	3	3	2	2	1									
CO6	3	3	3	2	2	2							3	3	2

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

COURSE CONTENT
THEORY

Contents
UNIT-1
Algorithm: Definition, Purpose of writing an algorithm, Rules for writing an algorithm, Advantage of writing algorithm and examples. Flowchart: Definition, Notations used to write a flow chart, Advantage and disadvantages of writing the flowchart and examples. Introduction to "C": Introduction to GitHub, Structure of C program with example, C language & its features, C tokens, data types in C, variables, constants, input and output functions
UNIT-2
Operators and Expressions: Unary operator, assignment operator, arithmetic operator, relational operators, logical operators &bitwise operator, conditional operator, increment and decrement operator, special operator. Conditional Statements: if statement, if-else statement, nested if, switch statement. Unconditional Statements: break and continue statement, goto statement, return statement Iterative Statements (loops): while loop, do-while, for loop, differences between while, do-while and for loop.
UNIT-3
Arrays: one dimensional array, two dimensional array, Linear and binary search and bubble sorting. Functions: Structure of a function, types of functions, parameter passing mechanisms, Command line arguments. Strings: string operations with and without using inbuilt string functions.
UNIT-4
Structures & Union: Derived types- structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, union, typedef. Pointers: Introduction to pointers. File Operations: Formatted Input & Output, Character Input and Output Functions, Direct Input and Output Functions, File Positioning Functions, Error Functions

PRACTICE:

PART A:			
No	**Titleof theExperiment**	**Tools and Techniques**	**ExpectedSkill /Ability**
1	Consider Loan applications in a bank consisting of various customer details such as Name, Organization, salary and loan amount applied. Segregate the loan applications based on income (low: <=5 lpa, medium: >5lpa <10lpa and high:>10lpa)	Condition checking	Apply if-else and switch
	Two files DATA1 and DATA2 contain sorted lists of integers. Write a C program to merge the contents of two files into a third file DATA i.e., the contents of the first file followed by those of the second are placed in the third file. Display the contents of DATA.	Files operations	Apply File concepts
2	Statistical measures are used for data analysis and interpretation. Develop program to determine the mean and stand deviation of data stored in an array.	Statistical Computing	Use Array and loops
	Consider the details of Airline passengers such as Name, PAN-No., Mobile-no, Email-id, Source, Destination, Seat-No and Air-Fare. Develop a program to read the details of airline passengers, store them in the structure "Airline" and List details of all the passengers who travelled From "Bengaluru to London".	Search technique	Apply Structures

3	Assume that Mr. Peterson shopped N items at Big Market and his Cart comprises of name of the item, cost of the item per UNIT and quantity. Read the details of shopping and store them in the structure "Shop". Compute the total amount spent on shopping at Big Market and also find out the item with minimum and maximum cost.	Statistical measure	Apply Structure and if then else
	b. Write a C program to define a structure named Student with name and DOB, where DOB in turn is a structure with day, month and year. Read the details of student and store them in the structure "Student". Display name and date of birth of students using the concept of nested structures.	Nested Structures	Apply Nested Structures
4	Consider a set of N students with SRN, name, and marks scored in 8 subjects. Read the details of students and store them in the structure "Student_Marks". Compute total marks and average marks of each student and display them with suitable headings.	Average computation and visualization	Apply Structure, Array and Loops
	b. Create the structure "Book" with book_id, title, author_name and price. Write a C program to pass a structure as a function argument and print the book details.	Functions	Passing structures to function
5	Assume that Ms. Jassica shopped N items at Amazon and the Cart comprises of name of the item, cost of the item per UNIT and quantity. Arrange the items in the increasing order of cost of the item per UNIT.	Sorting	Apply sorting the contents of structure.
	Write a C program to compute the monthly pay of "N" employees using each employee's name, Basic_Pay, DA and HRA. The DA and HRA are 80% and 30% of the Basic_Pay respectively. Gross-salary is computed by adding DA and HRA to Basic_Pay. Store all the details in an array of structures and print the name and gross salary of each employee.	Reading and storing data	Use structures for reading and storing data
6	a. Consider the details of "N" Faculty members consisting of Name, EMP-ID,name of the school, address and salary. Create a file to store the above details. Retrieve the contents of the file to perform following operations: (i) Display the details of the faculty based on salary range entered. (ii) Display the details of the faculty based on the EMP-ID entered.	File operations	Create file, store data and display details.
	b. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if else and switch case.	String operations	Apply string functions

PART B:			
	Project 1: Address Contact List with the following modules: User Add User(Name, Address, Primary contact number, secondary contact number, E-mail ID) Delete User Search for User Edit Find and replace the user name Edit the contact (Phone Number) details. Edit the Address of the user Report List of users based on the starting letter of their names. List of users based on first 2 digits of their mobile number. List of users based on the domain name of their E-mail ID.		
1	Develop a program in C to create the structure "Contact" with the fields, user_name, address, mobile, phone1 and email_id. Read the data into the structure "Contact" and store them in the file "Contact.txt".	Structures and Files	Develop the program using Structures and Files
2	Develop a program in C to open contact list from the file "Contact.txt" in read mode and delete contact details of the person based on name of the person by searching his/her details. Display the updated list.	String, File and Linear Search	Develop the program using String and File
3	Develop a program in C to input the string,"Str1"(which can be either a mobile no. or name of the user) and search for it in the file , "Contact.txt" and display the details if it is found else display an error.	String, File and Linear Search	Develop the program using String and File
4	Develop a program in C to input the name of the user into the string, "Str1" , search for it in the file "Contact.txt" and replace the content of "Str1" with the new data if found.	String, File and Linear Search	Develop the program using String, File and apply linear search
5	Develop a program in C to input the phone number of user into the string, "Str1", search for it in the file "Contact.txt" and edit it with new data if found and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
6	Develop a program in C to input the address of the user and search for the same in the file, "Contact.txt" and edit the address with new address and save the same.	String, File and Linear Search	Develop the program using String, File and apply linear search
7	Develop a program in C to input a letter into "Letter", compare it with the details stored in "Contact.txt" and then display the list of the users whose name begin with "Letter ".	File operations	Develop the program using file
8	Develop a program in C to input first two digits of a mobile number into "Mobile", search for the same in "Contact.txt" and display the details of all the users whose mobile number begin with "Mobile".	File operations	Develop the program using file
9	Develop a program in C to input a domain name of email-id and search for the same in the file, "contact.txt" and list the details of the users whose email-id matches with the given domain name.	File operations	Develop the program using file

TEXT BOOKS:

1. B.W. Kernighan & D.M. Ritchie, "C Programming Language", 2nd Edition, PRENTICE HALL SOFTWARE SERIES, 2005.
2. Herbert Schildt, “C: The Complete Reference”, 4th edition, TATA McGraw Hill, 2000.
3. B.S. Anami, S.A. Angadi and S. S. Manvi, “Computer Concepts and C Programming: A Holistic Approach”, secondedition, PHI,2008.

REFERENCE BOOKS:

1. Balaguruswamy,” Programming in ANSI C”, 4th edition, TATA MCGRAW Hill, 2008.
2. Donald Hearn, Pauline Baker,“Computer Graphics C Version”, second edition, PearsonEducation, 2004.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=6294
   (IEEE Journal/Magazine on IT Professional)
2. https://ieeexplore.ieee.org/document/1267572
   (IEEE Computing in Science and Engineering)

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs06/preview
   (Problem Solving through Programming in C)
2. https://www.edx.org/course/c-programming-getting-started
   (C Programming Getting started)
3. https://www.coursera.org/specializations/c-programming
   (Introduction to C programming)

SELF-LEARNINGEXERCISES

1. **Fundamentals of computer graphics**: output primitives–Line, Circle and Ellipse drawing algorithms-Attributes of output primitives.
2. **Inline Assembly Language Program:** Simple inline assembly,Extended Assembly Syntax Microsoft C Compiler.

Course Title	IoT and Applications				Course Type		Integrated	
Course Code	B20EC0101	Credits	2		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	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**2**	**3**	**3**	**13**	**26**	**30%**	**30%**

COURSE OVERVIEW

The Internet of Things (*IoT)* expands access to the world-wide web from computers, smartphones, and other typical devices to create a vast network of appliances, toys, apparel, and other goods that are capable of connecting to the Internet. This introductory course focuses on IoT architecture, its domains and communication protocols. The course is supported with hands on sessions that incorporates different types sensors interfaced with IoT board to build IoT projects to solve real time problems. The case study of deployment of IoT in various applications are provided.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the architecture of Internet of Things.
2. Inculcate knowledge of IoT devices, Sensors and Communication Protocols in various application domains.
3. Gain expertise in interface of various sensors to IoT Boards.
4. Discuss the various applications of IoT.
5. Learn new technologies in the IoT and apply for suitable application development.
6. Develop simple IoT projects and modules.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the architecture of IoT eco-system	1	1,2
CO2	Identify IoT devices, architecture, sensors and Communication protocols	1	1,2
CO3	Demonstrate the interface of sensors to IoT board	1,5, 12	1,2
CO4	Realize various Applications of IoT through case studies	1,5, 12	1,2
CO5	Learn new technologies in the IoT and apply for suitable application development.	1,5,9, 12	1,2
CO6	Develop simple IoT projects and modules	1,5,6,9, 12	1,2

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

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3	3	
CO2	3												3	3	
CO3	3				3							3	2	2	
CO4	3				3							3	1	1	
CO5	3		2		3				2				1	1	1
CO6	3				3				2			3	3	3	

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

COURSE CONTENT
THEORY

Contents
UNIT-I
IoT Basics: Introduction to IoT, How does Internet of Things Works, Features of IoT, Advantages and Disadvantages of IoT, Embedded Devices in IoT, IoT eco-system **IoT Architecture and IoT Devices**: Components of IoT architecture, Stages of IoT solution architecture, Smart Objects, IoT Devices.
UNIT-II
IoT boards in Market: Arduino, Arduino UNO, ESP8266, Raspberry Pi **IoT Platform:**Amazon Web Services (AWS) IoT platform,Microsoft Azure IoT platform,Google Cloud Platform IoT,IBM Watson IoT platform, ThingWork IoT platform Technologies Used in IoT: Bluetooth, Wi-Fi, Li-Fi, RFID, Cellular, Z-Wave

PRACTICE:

No	Titleof theExperiment	Tools and Techniques	ExpectedSkill /Ability
1.	Introduction to IoT Board	Hardware	Identifications of various parts of Arduino and Node MCU boards Study of Ethernet shield and connection to the board
	Arduino UNO		
	Arduino Nano		
	Node MCU		
	Ethernet Shield		
2.	Working with Arduino IDE (Integrated Development Environment)	Open source Arduino IDE	Download specified software Modify code as per the application
3.	a) Demonstration of Multimeter usage	Multimeter Breadboard Resistor packs	Measurement of voltage at various points in IoT boards Choose the value of Resistor for an application
	b) Demonstration of Breadboard connection for Voltage, Ground, series and parallel connections		
	c) Exercise to read the value of resistor using Color code chart		
4	Reading photo resistor sensor value connected to Arduino Board	Arduino UNO Arduino IDE LDR, Multimeter, Resistor	Interface of photo sensor to IoT board for light measurement applications
5	Reading temperature sensor value connected to Arduino Board	Arduino UNO, Arduino IDE, Temperature sensor, Multimeter	Interface of Temperaturesensor to IoT board for temperature measurement application
6.	Reading motion detector sensor value connected to IoT board	Arduino UNO, ArduinoIDE, pyro-dielectric sensor,	Interface of Motion detector sensor to IoT board for motion detection applications
7	Reading distance measurement using Ultrasonic sensor Connected to IoT board	Arduino UNO, Arduino IDE, Ultrasonic sensor, Multimeter	Interface of Motiondetector sensor toIoT board for motion detection
8	Interface relay to IoT board	Arduino UNO, Arduino IDE, relay Multimeter	Interface relay to IoT board for switchingapplications
9	Connect Wifi-ESP8266 to Arduino UNO board , Send and receive data through smart phone.	Arduino UNO ESP8266, Arduino IDE Smart phone	Connect IoT board to Wifi network
9	Mini Projects Arduino Controlled Light intensity Thermometer Motion activated light lamp Touchless motion sensor trash can		

TEXTBOOK:

1. Vijay Madisetti, ArshdeepBahga," Internet of Things: A Hands-On- Approach", ISBN: 978 0996025515,2014.

REFERENCEBOOKS:

1. Raj Kamal," Internet of Things: Architecture & design Principle", McGraw Hill Education,2017.

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/learn/iot
2. https://www.coursera.org/learn/interface-with-arduino

SELF-LEARNINGEXERCISES:

a) Create Arduino project hub

Course Title	ENTREPRENEURSHIP				Course Type		Theory	
Course Code	B20ME0104	Credits	1		Class		II semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Course Description: This is an *introductory course* is designed to provide the foundational concepts of *entrepreneurship*, including the definition of *entrepreneurship*, the profile of the *entrepreneur*, and the role of venture creation in society. The course also provides a bird's eye view on the steps to start a venture, financing, marketing as well as support by various institutions towards entrepreneurship.

COURSE OBJECTIVE

1. To understand the basic terms, concepts in Entrepreneurship Development
2. To apply for the supporting schemes towards entrepreneurship

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand and explain the key terms, definitions, and concepts used in Entrepreneurship Development	1	1
CO2	Plan a startup and understand sources available for finance and the supporting schemes offered by state and central governments and other entrepreneurial development organizations	1,2	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2	2											2	1	

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

COURSE CONTENT

THEORY

Contents
UNIT-1 **INTRODUCTION TO ENTREPRENEURSHIP** Evolution of term 'Entrepreneurship', Factors influencing entrepreneurship', Psychological factors, Social factors, Economic factors, Environmental factors. Characteristics of an entrepreneur, Difference between Entrepreneur and Entrepreneurship, Types of entrepreneurs. New generations of entrepreneurship viz. social entrepreneurship, Edupreneurship, Health entrepreneurship, Tourism entrepreneurship, Women entrepreneurship etc., Barriers to entrepreneurship, Creativity and entrepreneurship, Innovation and inventions, Skills of an entrepreneur, Decision making and Problem Solving
UNIT-2 **INSTITUTIONAL SUPPORT FOR ENTREPRENEURSHIP** Organization Assistance to an entrepreneur, New Ventures, Industrial Park (Meaning, features, & examples), Special Economic Zone (Meaning, features & examples), Financial assistance by different agencies, MSME Act Small Scale Industries, Carry on Business (COB) licence, Environmental Clearance, National Small Industries Corporation (NSIC), e-tender process, Excise exemptions and concession, Exemption from income tax, The Small Industries Development Bank of India(SIDBI), Incentives for entrepreneurs

TEXTBOOKS:

1. K. Ramachandran," Entrepreneurship Development", Tata Mc. Graw Hill, 2008.
2. Sangeeta Sharma, "Entrepreneurship Development", PHI Publications, 2016.

REFERENCE BOOKS:

1. Baringer and Ireland, "Entrepreneurship", 11th Edition, Pearson,2020.
2. P. Narayana Reddy, "Entrepreneurship – Text and Cases", Cengage Learning India, Iedition,2010
3. Paul Burns,"Corporate Entrepreneurship: Building The Entrepreneurial Organization", PalgraveMacmillan.
4. Drucker F Peter,:"Innovation and Entrepreneurship", 1985.Heinemann,London.

5. Doanld F Kuratko&Richard M ,"Entrepreneurship in the New Millennium", India Edition.

JOURNALS/MAGAZINES

1. International Small Business Journal: https://journals.sagepub.com/home/isb
2. Journal of Development Entrepreneurship: https://www.worldscientific.com/worldscinet/jde

SWAYAM/NPTEL/MOOCs:

1. Entrepreneurship: https://nptel.ac.in/courses/110/106/110106141/

SELF-LEARNINGEXERCISES:

1. Introverts participate. If you have a few vocal students asking questions and little participationfrom others, anonymous questions lower student anxiety, which makes it easier for everyone to participate.
2. You learn what students are thinking about. Anonymity provides cover for students to ask questions they may be too afraid to ask but are curious about.
3. Discussions start. Anonymity means you can invite students to pose "challenging" questions. Ifyou encourage your students to question what they're learning, why it's important, or why they should have to do the work you're assigning, you spark discussions about how entrepreneurshipis relevant, which can often be the key to increasing engagement.

PROBLEMBASEDLEARNING

No.	
1	How to write a Business Plan
2	Creating Marketing, Financial and Organizational Plans.
3	How to apply for financial assistance via various schemes
4	How to file taxes as a Small Business and understand the importance of GST

Detailed Syllabus
Semester -3

<table>
<tr><td>Course Title</td><td colspan="4">Analog and Digital Electronics</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20CI0301</td><td>Credits</td><td colspan="2">4</td><td colspan="2">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 colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

This course covers basic concepts of Electrical Engineering. The course introduces the working of analog components and helps in understanding basics in digital electronics by applying the knowledge of logic gates and learning the applications of diodes and opamps. The course provides foundation on designing and implementation of logic circuits. Analog circuits are simulated using ORCAD tool and digital circuits using XILINX tool which helps in gaining experience in creating and testing of circuits.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the applications of diode in rectifiers, filter circuits and wave shaping.
2. Describe the foundation on designing, building and testing of common combinational and sequential Digital logic circuits.
3. Explain the procedure required for simulation of digital logic circuits.
4. Analyze the working principle and designing of analog circuits using ORCAD tool
5. Analyze the working principle and designing of digital circuits using XILINIX tool
6. Demonstrate the use of general electronic instruments in design and testing of digital logic circuits.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the use of diodes in rectifiers, filter circuits and wave shaping	1 to 4	1
CO2	Apply the basic knowledge used in solid state electronics including diodes, and operational amplifiers for specific engineering applications.	1 to 3, 5	1
CO3	Identify the different families of digital integrated circuits build, and troubleshoot combinatorial circuits using digital integrated circuits	1 to 5	2
CO4	Analyze the working principle and designing of analog circuits using ORCAD tool	1 to 4	1
CO5	Analyze the working principle and designing of digital circuits using XILINIX tool	1 to 4	1
CO6	Develop the ability to analyze and design analog electronic circuits using discrete components	1,4,5	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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2									3		
CO2	3	2	3		2								3		
CO3	3	1	2	1	2									3	
CO4	3	1	1	2									3		
CO5	3	1	1	2									3		
CO6	3			2	2										3

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

COURSE CONTENT

THEORY:

UNIT – 1

Limiters and Oscillators: Clipping and clamping circuits using diodes, Oscillator operation, Phase shift Oscillator, Wien bridge Oscillator, Tuned Oscillator circuits, Crystal Oscillator. (BJT Version Only) Simple design methods of Oscillators.

UNIT- 2

Operational Amplifiers: Ideal Opamp versus Practical Opamp, Performance Parameters, Some Applications: Peak Detector Circuit, Absolute Value Circuit, Comparator, Active Filters-First order LPF and HPF, Phase Shifters, Instrumentation Amplifier, Non-Linear Amplifier-Log and antilog amplifier.

UNIT – 3

Principle and Minimization Techniques of combinational Circuits: Introduction to combinational logic, Minimization Techniques: Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS), 3 and 4 Variable Karnaugh map.

UNIT – 4

Analysis of Combinational and sequential Circuits: Half adder, full Adder, Half Subtractor,fullSubtractor,multiplexers and Demultiplexers.
Introduction to Sequential circuits: flip-flops: SR, JK, D, T Characteristic tables and equations; Application of Shift register (Ring Counter and Johnson counter) .

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	To simulate a positive clipper, double ended clipper & positive clamper circuits using diodes	Orcad	Simulation of clipper and clamper electronic
2	To simulate a rectangular wave form generator (Op-amp relaxation oscillator) and compare the frequency and duty cycle with the design specifications	Orcad	Simulation of rectangular waveform generator
3.	To simulate a Schmitt trigger using Op-amp and compare the UTP andLTP values with the given specification	Orcad	Simulation of Schmitt trigger
4.	To simulate a Wien bridge Oscillator	Orcad	Simulation of wein bridge oscillator
5.	To determine the working of a power supply and observe the waveforms	Orcad	Simulationof power supply
6.	To build and simulate CE amplifier (RC coupled amplifier) for itsfrequency response and measure the bandwidth.	Orcad	Simulation of RC coupled amplifier and

			determining the frequency response
7.	Realization of Half/Full adder and Half/Full Subtractors using logic gates	ICs, Trainer kit and patch cords Create and perform the adder and subtractor circuits	ICs, Trainer kit and patch cords Create and perform the adder and subtractor circuits
8.	Design and develop VHDL code to realize Full adder and Full Subtractors	Xilinx	Simulation knowledge of the mentioned adders an
9.	.Given a 4-variable logic expression, simplify it using Entered Variable Map and realize the simplified logic expression using 8:1 multiplexer IC	ICs, Trainer kit and patch cords	Realization of a multiplexer
10.	Design and develop the VHDL code for an 8:1 multiplexer. Simulate and verify it's working	Xilinx	Simulation knowledge of combinational logic circuit
11.	Design and implement a ring counter using 4-bit shift register and demonstrate its working	ICs, Trainer kit and patch cords	Realization of shift register and ring counter
12.	Design and develop the Verilog / VHDL code for switched tail counter.	Xilinx	Simulation of ring counter

TEXTBOOKS:

1. Anil K Maini, Varsha Agarwal," Electronic Devices and Circuits", Wiley, 2009.
2. Jacob Millman, Christos Halkias, Chetan D Parikh," Millman's Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010.
3. Donald P Leach, Albert Paul Malvino&GoutamSaha," Digital Principles and Applications", 7th Edition, Tata McGraw Hill, 2010.

REFERENCEBOOKS:

1. Stephen Brown, ZvonkoVranesic," Fundamentals of Digital Logic Design with VHDL", 2nd Edition, Tata McGrawHill, 2005.
2. R D Sudhaker Samuel, "Illustrative Approach to Logic Design", Sanguine-Pearson, 2010.
3. Charles H. Roth," Fundamentals of Logic Design", Jr., 5th Edition, Cengage Learning, 2004.
4. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss," Digital Systems Principles and Applications", 10th Edition, Pearson Education, 2007.
5. M Morris Mano," Digital Logic and Computer Design", 10th Edition, Pearson Education, 2008.
6. Jacob Millman, Christos Halkias, "Analog and Digital Circuits and Systems", 2nd Edition, Tata McGraw Hill, 2010
7. R. D. Sudhaker Samuel," Electronic Circuits", Sanguine-Pearson, 2010

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/1085417
2. https://www.academia.edu/Documents/in/Digital_Electronics
3. https://www.mdpi.com/journal/electronics/special_issues/circuit_machine_learning

SWAYAM/NPTEL/MOOCs:

1. https://technobyte.org/digital-electronics-logic-design-course-engineering/
2. https://www.udemy.com/course/digital-electronics-logic-design/
3. https://www.javatpoint.com/digital-electronics/.

Course Title	Programming with JAVA				Course Type		Integrated	
Course Code	B20CI0302	Credits	4		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

Java's unique architecture enables programmers to develop a single application that can run across multiple platforms seamlessly and reliably. In this course, students gain extensive experience with Java, object-oriented features and advance Java programming skills. Students learn to create robust object-oriented applications with Java.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic data types and control structures of the Java language.
2. Illustrate the creation of classes and objects in Java.
3. Demonstrate the extending a class (inheritance) and use proper program anomaly handling structures.
4. Discuss the use of Java generics and collections.
5. Discuss object-oriented features and advance Java programming skills
6. Explain to create robust object-oriented applications with Java.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of array concepts in java to solve real world problems.	1 to 5	1
CO2	Apply the features of OOPS in java to solve the real-world problems.	1 to 5	1
CO3	Develop program for stack implementation using Exception Handling in java.	1 to 5	2, 3
CO4	Identify suitable data structures to solve real world applications.	1 to 5, 12	2
CO5	Discuss object-oriented features and advance Java programming skills	1 to 5	1
CO6	Explain to create robust object-oriented applications with Java.	1 to 5, 12	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

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1								3		
CO2	3	3	2	2	1								3		
CO3	3	3	1	1	1									3	3
CO4	3	3	3	1	2							1		3	
CO5	3	3	3	1	2								3		
CO6	3	3	2	2	2									3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

Fundamental Programming Structures: Dissecting the "Hello, World" Program; Compiling and Running a Java Program; Primitive Types; Variables; Arithmetic Operations; Strings; Input and Output; Control Flow; Arrays; Functional Decomposition.

UNIT – 2

Object-Oriented Programming: Working with Objects; Implementing Classes; Object Construction; Static Variables and Methods, Packages; Nested Classes; Documentation Comments; Interfaces; Static, Default and Private Methods in interface; Lambda Expressions; Method and Constructor References; Local and Anonymous Classes.

UNIT – 3

Inheritance and Exceptions: Extending a Class; Object: The Cosmic Superclass; Enumerations; Runtime Type Information and Resources; Exception Handling: Throwing Exceptions; The Exception Hierarchy; Declaring Checked Exceptions; Catching Exceptions; the Try-with-Resources Statement; The finally Clause; Rethrowing and Chaining Exceptions; Uncaught Exceptions and the Stack Trace.

UNIT – 4

Generic Programming and Collections: Generic Classes; Generic Methods; Type Bounds; Type Variance and Wildcards; Restrictions on Generics; an Overview of the Collections Framework; Iterators; Sets; Maps.

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1.	The sieve of Eratosthenes is one of the most efficient ways to find all primes smaller than n when n is smaller than 10 million. Given a number n, use JAVA to print all primes	Windows/Linux OS, IDE	Understanding conditional operators and statements
2.	The Gauss-Jordan method is also known as Gauss-Jordan elimination method is very useful in solving a linear system of equations. It is a technique in which a system of linear equations is resolved by the means of matrices. Develop a	Windows/Linux OS, IDE	Creating an array and performing some operations on array.
3.	To compute a square root of any positive number a, start with an initial guess x=x1 for √a; then calculate successive approximations x2,x3...,√a using the formula: $x_i = \frac{x_{i-1} + (a/x_{i-1})}{2}, i = 2, 3, \ldots$	Windows/Linux OS, IDE	Understanding conditional statements (if, if..else, etc)

4.	Model a lamp as a Java object. Make a Lamp class. This will contain atleast one instance variable which will be of type Boolean and will hold the state of the lamp: i.e., whether it is on or off. In addition, add methods to do the following things: switch the light on and off, and check its current state, i.e., whether it is on or off. Maintain proper encapsulation mechanism. Next, write a launcher class with a main() method to carry out the following tasks:	Windows/Linux OS, IDE	Object and class creation and its usage

5.	Given the following functional interface:
	interface MathOperation {
	int operation(int a, int b);
	}
	Develop an application that would implement the above interface using lambda expressions as to perform
		Windows/Linux OS, IDE	Creation of interfaces and its usage.

6.	The String class in JAVA has a static method compare To Ignore Case, which compares two strings and the Arrays class has a static sort method. Build a JAVA program that creates an array of strings, use the sort function from Arrays class to sort the strings by passing the compare To Ignore	Windows/Linux OS, IDE	Creation of string class and its usage
7	XYZ technologies is firm that has 5 employees with 1 manager, and 4 technicians. XYZ wants to digitize its payroll system, the following requirements: Dearness Allowance is 70% of basic for all employees. House Rent Allowance is 30% of basic for all employees. Income Tax is 40% of gross salary for all employees. The annual increments to the employees are to be given of the following criteria: - Manager 10% of the basic salary, and Technicians 15% of basic. Develop the pay roll for XYZ. Implement a class	Windows/Linux OS, IDE	Creation multiple inheritance and its usage
8	Define a new Exception class named Odd Exception. Create a new class named Even Odd. Write a method called halfOf(), which takes an int as parameter and throws an Odd Exception if the int is odd or zero, otherwise returns (int / 2). Write a main method that calls halfOf() three times (once each with an even int, an odd int, and zero), with three	Windows/Linux OS, IDE	Creation of exception class and its usage

9	Implement a class named Fraction that represents fractions with numerator and denominator always stored reduced to lowest terms. If fraction is negative, the numerator will always be negative, and all operations leave results stored in lowest terms. Implement the addition, subtraction, multiplication and division operation for the Fraction class	Windows/Linux OS, IDE	Creation of exception class and its usage
10	Create a class Student that has instance variables as Name, Age, Address and access transmutation methods to access the instance variables along with display method to print the details of student. Next write a main() function that will create a collection of 10 students and reverse the list. Print	Windows/Linux OS, IDE	Object and class creation and its usage
11	Use generics to build a class Sort. Implement the bubble sort algorithm to sort an array of any type.	Windows/Linux OS, IDE	Creation of generics class and its usage
12	Write a generic method to count the number of elements in a collection that have a specific property (for example, odd integers, prime numbers, palindromes).	Windows/Linux OS, IDE	Creation of generics class and its usage

Sl. No.	**Part B Mini Project**
1	Develop a project for Airline reservation system List with the following modules: 1. PASSENGER a) Add member b) Delete member c) Search for member d) Edit member 2. FLIGHT a. Add Flight b. Delete Flight c. Search Flight d. Display Flights 3. RESERVATION a. Book b. Cancel Title: Airline Reservation system Problem Definition: *Airline Reservation System*" main aim is to provide the online ticket & seat reservation of National and International Flights and give the information about flight departures. Solution: Develop a project to implement an Airline reservation system with the following modules: 1. PASSENGER a. Add member b. Delete member c. Search for member d. Edit member 2. FLIGHT a. Add Flight

	b. Delete Flight c. Search Flight d. Display Flights 3. RESERVATION a. Book b. Cancel
List of Experiments:	
Sl.No	Name of the Experiment
1	Create a passenger class with the attributes Adhar_number, Passenger_name, Email_id, Phone, Address, DOB and the methods to facilitate Addition, Deletion, Search and Modify the passenger data. Store the details of the 10 passenger objects in "Passenger.txt" and Display. a. void Add_passenger() b. Display_details() c. void Delete_Passenger(Adhar_number) d. void Search_Passenger(Adhar_number) e. void Modify_Passenger(Adhar_number)
2	It is required to delete an existing passenger data based on the request from the passenger. Read adhar card number of the passenger to be deleted and delete the record from "passenger.txt" if found. Otherwise display an error message saying that "record does not exist". Develop a program to implement the above task.
3	It is required to modify an existing passenger data based on the request from the passenger. Read adhar card number of the passenger to be modified and modify the record from "passenger .txt" if found. Otherwise display an error message saying that "Record does not exist". Develop a program to implement the above task.
4	It is required to Search an existing passenger data based on the request from the passenger. Read Adhaar card number of the passenger to be searched for, search the record from "passenger .txt" and display the details of passenger if found. Otherwise display the error message "Record does not exist". Develop a program to implement the above task.
5	Create a Flight class with attributes Flight_number, Flight_name, Source, Destination, Departure_Timing and the methods Add_Flight(), Delete_Flight(), Search_Flight() and Display_Flight(). Store the details of any 5 Flights in a file called "Flights.txt" and display the same. Develop a program to achieve the above task.
6	It is required to delete the details a flight stored in "Flights.txt". Read the Flight_no and search for the same in "Flights.txt". If found, it should be deleted from "Flights.txt". Otherwise display the error message "Flight Does Not Exist". Develop a program to achieve the above task.
7	It is required to delete the search for a flight stored in "Flights.txt". Read the Flight_no and search for the same in "Flights.txt". If found, Display the details of Fllight, otherwise display the error message "Flight Does Not Exist". Develop a program to achieve the above task.
8	It is required to display the details of all the flights running from Source1 to Destination1. Read the name of source1 and destination1 and fetch from "Flights.txt" the details of all the flights running between Source1 and desitnation1 and display the same. Develop a program to achieve the above task.
9	Create a reservation class that facilitates booking and cancellation of domestic and international flights using the following methods and parameters. Develop a program to store the details of 10 bookings in "**Reservations.txt"** and display the same. a. Book_Ticket(Flight_Number, Flight_Name, Ticket_Number,Source, Destination, Adhar_number, Passport_number,Date, Departure_time, Class, Type_of_Travel(Domestic , International), Fare, Status) b. Cancel_Ticket(Ticket_Number)
10	A passenger would like to cancel the ticket due to a genuine reason. Read the ticket_no and search for the record in "Reservation.txt". Cancel the Ticket based on the request from passenger and update the status.

TEXTBOOKS:

1. Cay S. Horstmann," Core Java® SE 9 for the Impatient", Addison Wesley, Second Edition, 2018.
2. HerbertSchild," Java™: TheCompleteReference",McGraw-Hill,TenthEdition,2018.
3. David Gallardo, Ed Burnette, Robert Mcgovern," Eclipse in Action a guide for java developers", Manning Publications,2003.
4. Ed Burnette;" Eclipse IDE Pocket Guide: Using the Full-Featured IDE", O'Reilly Media, Inc, USA,2005.

REFERENCEBOOKS:

1. Cay S. Horstmann," Core Java™ Volume I—Fundamentals", Prentice Hall, Tenth Edition, 2015
2. Joshua Bloch," Effective Java",Addison-WesleyProfessional, ThirdEdition,2017
3. Ken Kousen, " Modern Java Recipes", O'Reilly Media, Inc.,2017
4. Oracle Java Documentation. (https://docs.oracle.com/javase/tutorial/)

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/5464387
2. https://files.eric.ed.gov/fulltext/EJ1075126.pdf
3. https://www.sciencedirect.com/science/article/pii/S0167642304000590
4. https://www.informingscience.org/Publications/4322?Source=%2FJournals%2FJITEIIP%2FArticles%3FVolume%3D0-0
5. https://www.javadevjournal.com/
6. https://blogs.oracle.com/javamagazine/

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-LearningExercises:

1. The Eclipse-IDE
2. Streams
3. Concurrent Programming
4. Swing and JavaFX
5. Networking- JDBC, Database Access

Course Title	Data Structures	Course Type	Integrated

Course Code	B20CI0303	Credits	4		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, recursion, stack, queues, and binary trees, heaps, sorting and searching algorithms. It also covers analysis and design of fundamental data structures and engages learners to use data structures as tools to algorithmically design efficient computer programs that will cope with the complexity of actual applications.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss the concept of Abstract Data Types (ADT)
2. Provide the knowledge of stacks and queues.
3. Understand the importance of Linked lists
4. Illustrate the operations of trees
5. Demonstrate the use of appropriate of data structures for a given problem.
6. Design a data structure application for real time problems.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the Abstract Data Types, Structures.	1 to 5	1
CO2	Formulate the solution for any computational problem using stacks and queues.	1 to 5	1,2
CO3	Analyze the importance of linked lists.	1 to 5	1,2
CO4	Solve real time problems using trees data structure.	1 to 5	1,2
CO5	Apply appropriate data structures to solve a given problem.	1 to 5	1
CO6	Compare the performance of various data structures	1 to 5	1,2

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

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

COURSE CONTENT

THEORY:

UNIT- 1

Introduction to Data structures and Algorithms: Data, Data Types, Abstract Data Types and Examples, Algorithms, Arrays: One Dimensional and Two Dimensional, Structures: Introduction to structures and nested structures.

UNIT -2

Data Structures-1: Stacks, Evaluation of expressions: Infix, Prefix, postfix; Queues: Simple, circular and priority Queues.

UNIT- 3

Data Structures-2: Pointers;Dynamic memory allocation;Linked List: singly linked list, doubly linked list, stack using linked list, queue using linked list.

UNIT- 4

Data Structures-3: Trees: Binary Tree, Binary Tree Traversals, Binary search Tree.

Self-learning component:

AVL Trees, Threaded Binary Trees,Heaps, Sparse Matrix, Searching and sorting techniques

(Text books:

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

2. Joshi, Data Structures and Algorithms In C, Tata McGraw-Hill Education, 2010.

Reference books:

1. The design and analysis of computer algorithms, 4th Edition Addison-Wesley
2. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, Data Structures and Algorithms, Addison-Wesley, 1987.

3. Richard Gilberg, BehrouzForouzan, Data Structures: A Pseudo code Approach with C, Cengage Learning, 2004.

4. ACM Transactions on Data structures
5. ACM Journal of Algorithms and Computational Technology.

JOURNALS/MAGAZINES

1. https://www.imedpub.com/scholarly/data-structure-journals-articles-ppts-list.php
2. https://www.mdpi.com/journal/algorithms/special_issues/Efficient_Data_Structures
3. https://ieeexplore.ieee.org/document/4055607
4. https://ieeexplore.ieee.org/abstract/document/6312216
5. https://www.sciencedirect.com/science/article/pii/0022000083900065
6. https://www.sciencedirect.com/journal/journal-of-algorithms

SWAYAM/NPTEL/MOOCs:

1. Coursera – Data Structures and Algorithms Specialization
2. Coursera – Data Structures, University of California San Diego
3. Data Structures and Algorithms, National Research University Higher School of Economics
4. https://nptel.ac.in/courses/106/102/106102064/
5. https://nptel.ac.in/courses/106/106/106106127/
6. https://nptel.ac.in/courses/106/103/106103069/

Self-LearningExercises:

1. Storing game entities in a array
2. Pseudo-random number generators
3. Reversing an array using a stack
4. Matching parentheses and HTML tags
5. Double ended queue
6. Application of tree traversals

Pactise:

1	Design, Develop and Implement a menu driven Program in C for the following Array operations a. Creating an Array of N Integer Elements b. Display of Array Elements with Suitable Headings c. Inserting an Element (ELEM) at a given valid Position (POS) d. Deleting an Element at a given valid Position(POS) e. Exit. Support the program with functions for each of the above operations.
2	Design, Develop and Implement a Program in C for the following operations on Strings a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP) b. Perform Pattern Matching Operation:

	c. Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. d. Report suitable messages in case PAT does not exist in STR Support the program with functions for each of the above operations. Note: Don't use Built-in functions
3	Design, Develop and Implement a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a. Push an Element on to Stack b. Pop an Element from Stack c. Demonstrate how Stack can be used to check Palindrome d. Demonstrate Overflow and Underflow situations on Stack e. Display the status of Stack f. Exit Support the program with appropriate functions for each of the above operations
4	Design, Develop and Implement a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, %(Remainder), ^ (Power) and alphanumeric operands.
5	Design, Develop and Implement a Program in C for the following Stack Applications a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^ b. Solving Tower of Hanoi problem with n disks 21 6 Design, Develop and Imp
6	Design, Develop and Implement a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX) a. Insert an Element on to Circular QUEUE b. Delete an Element from Circular QUEUE c. Demonstrate Overflow and Underflow situations on Circular QUEUE d. Display the status of Circular QUEUE e. Exit Support the program with appropriate functions for each of the above operations
7	Design, Develop and Implement a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: USN, Name, Branch, Sem, PhNo a. Create a SLL of N Students Data by using front insertion. b. Display the status of SLL and count the number of nodes in it c. Perform Insertion and Deletion at End of SLL d. Perform Insertion and Deletion at Front of SLL e. Demonstrate how this SLL can be used as STACK and QUEUE f. Exit
8	Design, Develop and Implement a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: SSN, Name, Dept, Designation, Sal, PhNo a. Create a DLL of N Employees Data by using end insertion. b. Display the status of DLL and count the number of nodes in it c. Perform Insertion and Deletion at End of DLL d. Perform Insertion and Deletion at Front of DLL e. Demonstrate how this DLL can be used as Double Ended Queue f. Exit
9	Design, Develop and Implement a Program in C for the following operations on Singly Circular Linked List (SCLL) with header nodes a. Represent and Evaluate a Polynomial P(x,y,z) = 6x2y2z-4yz5+3x3yz+2xy5z-2xyz3 b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z) Support the program with appropriate functions for each of the above operations
10	Design, Develop and Implement a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2 b. Traverse the BST in Inorder, Preorder and Post Order c. Search the BST for a given element (KEY) and report the appropriate message d. Delete an element(ELEM) from BST e. Exit

Course Title	Discrete Mathematics and Graph Theory				Course Type		Theory	
Course Code	B20AS0302	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	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

Discrete Mathematics is the study of discrete objects. Discrete Mathematics is used to develop our ability to understand and create mathematical arguments and also used to provide the mathematical foundation for advanced mathematics and computer science courses.Graphs (abstract networks) are among the simplest mathematical structures, which are used in most of the areas of Computer Science to solve the complex problems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain mathematical arguments using logical connectives and quantifiers.
2. Illustrate the operation on discrete structures such as sets, relations and functions.
3. Describe the theory and application of graphs, fundamental theorems and their proofs.
4. Demonstrate the use of graphs to model many types of relations and processes in physical, biological. Social and information system.
5. Explain to provide the mathematical foundation for advanced mathematics
6. Illustrate to use discrete mathematics to solve the complex problems in most of the areas of Computer Science

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Construct mathematical arguments using logical connectives and quantifiers	1 to 4	2
CO2	Apply the operations like union and intersection on discrete structures such as sets, relations and functions	1 to 3, 5,6	2
CO3	Make use of graph and fundamental theorems in real world applications	1 to 6	2
CO4	Develop a model using advanced concepts of graph for real world applications	1,2,4,5,6	2
CO5	Apply the mathematical foundation for advanced mathematics	1 to 3, 5,6	2
CO6	Solvethe complex problems in most of the areas of Computer Science	1,2,3,4	3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

	Bloom's Level					
	Remember	Understand	Apply	Analyze	Evaluate	Create
CO1			√			
CO2			√			
CO3			√			
CO4			√			
CO5			√			
C06					√	

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2										3	
CO2	3	2	3		2	1								3	
CO3	3	1	2	1	2	3								3	
CO4	3	2		2	2	2								3	
CO5	3	2	3		2	1								3	
C06	3	2	3	3											3

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

COURSE CONTENT

THEORY:

UNIT – 1

Set Theory and Logic: Fundamentals of Sets, Sub sets, Venn diagram, Operations on sets, Laws of set theory, Countable and Uncountable sets, Addition Principle, Extended Addition Principle, Propositions, Logical Connectives and truth tables (Illustrative Examples), Logical equivalence, Laws of logic, Duality, NAND and NOR connectives (Circuits), Converse, Inverse and Contrapositive, Rules of Inference, Open statements, Quantifier, Logical implication involving quantifiers, Statement with more than one variable. Methods of Proofs and Disproof.

UNIT – 2

Relations and Functions : Cartesian product of sets (Illustrative Examples), Matrices and Digraph of the relations, Properties of relations, Equivalence relations, Partial ordered relations, Posets, Hasse diagrams, Extremal elements in posets, Types of Functions, properties of Functions, The pigeon hole principle, composite functions, invertible functions, Floor and ceiling functions, Sterling number of second kind.

UNIT – 3

Introduction to graph theory: Konigsberg's bridge problems, Utilities problem, Seating Problem, Graphs, Representation of Graphs. Directed graphs, Incidence, Adjacency, Degree, In degree, Out degree, Regular graphs, Complete graphs, Null Graph, Bipartite Graphs, Isomorphism, Directed Graphs, Sub graphs, Walk, Trail, Path, Circuit, Cycle, Connected and disconnected graphs, Components, Weakley connected and Strongly connected Components, Complement of graphs, Partition and Decompositions.

UNIT – 4

Euler and Hamiltonian graphs and Graph coloring: Operation on graphs, Definition of Euler Trail, Euler Graphs, Hamiltonian path, Hamiltonian Cycle, Hamiltonian Graphs, Standard Theorems on Euler and Hamiltonian graphs, planar graph, detection of Planarity, Dual of planar graphs, Euler formula for planar graph, Graph coloring, Chromatic polynomial, Map coloring, Four Color Theorem, Five Color Theorem, Matching, Network flow, and its applications, Cut set, Cut vertex, Chord, Properties of Cut Sets, Max Flow Min Cut Theorem.

TEXT BOOKS:

1. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, 2014.
2. NasinghDeo, "Graph Theory with Applications to Engineering Computer Science", Prentice-Hall, 2014.

REFERENCE BOOKS:

1. Keneth H Rosen, "Discrete Mathematics and its applications", 5th Edition,, Tata McGraw Hill, 2014.
2. C L Liu, "Elements of Discrete Mathematics", 4th edition, Tata MacGraw Hill 2014.
3. Thomas Khoshy, "Discrete Mathematics with applications", Elsvier, 2012.
4. Ralph P Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Asia, 2015.
5. Frank Harary, "Graph Theory", Norosa, 2013.
6. J. A. Bondy and V. S. R. Murthy,"Graph Theory with Applications", Macmillan, London, 2013.

JOURNALS/MAGAZINES

1. https://www.journals.elsevier.com/discrete-mathematics
2. http://www.math.iit.edu/~kaul/Journals.html
3. https://www.siam.org/publications/journals/siam-journal-on-discrete-mathematics-sidma
4. https://onlinelibrary.wiley.com/journal/10970118
5. https://iopscience.iop.org/article/10.1088/1742-6596/1175/1/012069/meta
6. https://iopscience.iop.org/article/10.1088/1742-6596/1188/1/012065/meta
7. https://www.worldscientific.com/worldscinet/jml
8. https://www.scimagojr.com/journalsearch.php?q=12000154480&tip=sid

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/111/107/111107058/
2. https://nptel.ac.in/courses/106/103/106103205/
3. https://onlinecourses.swayam2.ac.in/cec20_ma02/preview
4. https://onlinecourses.nptel.ac.in/noc20_ma05/preview
5. https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
6. https://www.coursera.org/learn/graphs

Course Title	Computer Organization and Architecture				Course Type		Theory	
Course Code	B20EK0301	Credits	3		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Computer organization and architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance, and cost goals. Computer organization defines the constituent parts of the system, how they are interconnected, and how they interoperate in order to implement the architectural specification. In this course, student will learn the basics of hardware components from basic arithmetic units to memory and I/O devices, instruction set architectures and assembly language, and designs to improve performance.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain architecture of ARM processor and write simple assembly programs.
2. Demonstrate the translation of assembly instructions into their binary representation.
3. Describe and understand the processor memory hierarchy.
4. Discuss basic understanding of interrupts, I/O devices, and I/O protocols

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of ARM processor instruction set for developing simple assembly Interpret the functional architecture of computing systems.	1,2,7,12	1
CO2	Interpret the functional architecture of computing systems.	1,2,4,10	1
CO3	Identify the issue related to instruction set architecture ,memory unit and control unit and I/O functions.	1,11	1
CO4	Develop a real world application using parallel processing concepts.	1,2,4,10,11	1,2
CO5	Learn new tools and technologies in the computer organization and architecture and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the computer organization and architecture to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3					3					1	3		
CO2	3	3		2						2			3		
CO3	3										2		3		
CO4	3	3		2						2	2		3	2	

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

COURSE CONTENT

THEORY:

UNIT-1

Introduction to ARM processor: Introduction to the architecture of Microprocessor, Microcontroller, Microcomputer and Internet of Things (IoT). ARM characteristics, Registerstructure, Addressing modes, Instructions, Assembly language, Operating Modes and Exceptions, Conditional execution of Instructions.

UNIT-2

Arithmetic unit: Addition and Subtraction of Signed Numbers**,** Multiplication of unsigned numbers, Multiplication of signed numbers, Fast multiplication, Integer division, Floating point numbers and operations, Arithmetic operations on floating point numbers.

UNIT-3

Memory System: Basic concepts, Synchronous RAM memories, Read-only memories, Direct Memory Access, Memory Hierarchy, Cache memories, Virtual memory.

UNIT-4

Input/output Organization: Bus structure, Bus operation, Arbitration, Interface circuits, Intercommunication standards.

Parallel processing: Hardware multithreading, Vector (SIMD) processing and Shared Memory multiprocessors.

TEXTBOOKS:

1. Carl Hamacher ,ZvonkoVranesic, SafwatZaky, NaraigManjikian, "Computer Organization and Embedded Systems", Sixth Edition, McgraHIll.

REFERENCEBOOKS:

1. Linda Null, Julia Labor, "The Essentials of Computer Organization and Architecture", Viva Publishers, 4th Edition, 2015.
2. William Stallings. "Computer organization and architecture: designing for performance". Pearson Education India, 2000.
3. David A. Patterson, John L. Hennessy. "Computer organization and design: the Hardware/software interface". Elsevier, 2011.
4. Peter Knaggs , "ARM Assembly Language Programming", April 2016.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1646340
2. https://ieeexplore.ieee.org/document/7160433
3. https://www.academia.edu/Documents/in/Computer_Architecture_and_Organisation
4. https://dl.acm.org/doi/10.5555/1610377

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105163/
2. Computer Architecture Overview -Coursera

SELF-LEARNINGEXERCISES:

Intel IA-32 architecture, Instruction Set Architecture of IA-32, Basic Input/Output, Basic processing unit and Pipelining

Course Title	Management Science				Course Type		Theory	
Course Code	B20MGM301	Credits	2		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**0**	**50**	**50**

COURSE OVERVIEW

The course intends to familiarise students to understand the management principles and applications, which lays a strong foundation for managers and leaders in critical thinking and decisions making process. The course emphasises on giving an overview of the functional area of management

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	To Plan organizational structure for a given context in the organisation carry out production operations through Work-study.	1-5	2
CO2	To carry out production operations through Work-study.	1-5	3
CO3	To Understand the markets, customers and competition better and price the given products Appropriately.	1-5	2
CO4	To Plan and control the HR function better.	1-5	2,3
CO5	To create foundation of decision making process and critical thinking	1-6	3
CO6	To emphasises on giving an overview of the functional area of management	2,4	2

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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3									3	
CO2	1	1	3	3	3										3
CO3	1	3	2	3	1									3	
CO4	1	1	3	2	5									3	3
CO5	1	1	2	3	2	2									3
CO6		1		2										3	

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

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to Management and Organisation: Concepts of Management and organization- nature, importance and Functions of Management. Systems Approach to Management – Taylor's Scientific Management Theory- Taylor's Principles of Management, Maslow's theory of Hierarchy of Human Needs- Douglas McGregor's Theory X and Theory– Hertzberg Two Factor Theory of Motivation – Leadership Styles, Social responsibilities of Management. Designing Organisational Structures: Basic concepts related to OrganisationDepart mentation and Decentralisation.

UNIT – 2

. **Operations and Marketing Management**: Principles and Types of Plant Layout-Methods of Production(Job, batch and Mass Production), Work Study –Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering(BPR) Statistical

Quality Control: control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Deming's contribution to quality. Objectives of Inventory control, EOQ, ABC Analysis. Purchase Procedure, Stores Management and Store Records – JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix. And Marketing Strategies based on Product Life Cycle. Channels of distribution.

UNIT – 3

Human Resources Management (HRM): Concepts of HRM. HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR.. Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development. Placement, Wage and Salary Administration, Promotion. Transfer, Separation, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating -Capability Maturity Model (CMM) Levels – Performance Management System.

UNIT – 4

Strategic Management and Contemporary strategic Issues: Mission, Goals, Objectives, Policy, Strategy. Programmes, Elements of Corporate Planning Process, Environmental Scanning. Value Chain Analysis, SWOT Analysis. Steps in Strategy Formulation and implementation, Generic. Strategy alternatives. Bench Marking and Balanced Score and as Contemporary Business Strategies.

TEXTBOOKS:

I. Kotler Philip and Keller Kevin Lane, Marketing Management, Pearson, New York, 15th Edition, 2012.
2. Koontz and Weihrich: Essentials of management, McGraw Hill, New Delhi, 11th Edition, 2012.

REFERENCEBOOKS:

1. Thomas N. Duening and John M. Ivancevich, Management – Principles and Guidelines, Dreamtech Press; 1st Edition, 2012.
2. Samuel C. Certo, Modern Management, Prentice Hall, New York, 9th Edition, 2012.
3. Schermerhorn, Capling, Poole and Wiesner, Management, Wiley, New York, 6th Edition, 2012.
4. John A. Parnell, Strategic Management – Theory and Practice, Cengage Publications, 2018.
5. Lawrence R Jauch, R. Gupta and William F. Glucek: Business Policy and Strategic Management Science, McGraw Hill, New York, 5th Edition, 2012.

Course Title	Environmental Science				Course Type		Theory	
Course Code	B20AS0303	Credits	2		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**0**	**50**	**50**

COURSE OVERVIEW

This course intends to understand, analyze and execute the environmental conditions and the control measures on various types of pollutions can be recognized. This course also talks about the environmental degradation on global warming, acid rain formation, and waste management and how the energy and natural resources can be used effectively in ecosystem.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Graduates will be familiar with current and emerging environmental engineering and global issues, and have an understanding of ethical and societal responsibilities.
2. Graduates will have the ability to obtain the knowledge, and will recognize the need for engaging in life-long learning.
3. Will find the need of various types of energy (conventional & non-conventional) resources and natural resources.
4. Acquire knowledge with respect to biodiversity, threats, conservation and appreciate the concept of ecosystem.
5. Acquire knowledge about sources, effects and control measures of environmental pollution, degradation and waste management.
6. Explore the ways for protecting the environment.

COURSE OUTCOMES (Cos)

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

CO#	Course Outcomes	Pos	PSOs
CO1	Understand, analyse and execute favourable environmental conditions and the role of individual, government and NGO in environmental protection.	1-5	2
CO2	List the causes, effects & remedial measures and find ways to overcome them by suggesting the pollution-controlled products.	1-5	3
CO3	Classify different wastes, sources of waste and their effect on population	1-5	2,3
CO4	Get motivation to find new renewable energy resources with high efficiency through active research and innovation and criticallyanalyse the ecological imbalances and provide recommendations to protect the environment.	1-5	2,3
CO5	To learn about increase in population growth and its impact on environment	2,3,4	3

CO6	To Gain knowledge about environment and ecosystem	1-5	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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3									3	
CO2	1	1	3	3	3										3
CO3	1	3	2	3	1									3	3
CO4	1	1	3	2	5									3	3
CO5		2	2	2											3
CO6	1	2	2	2	2										3

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

COURSE CONTENT

THEORY:

UNIT – 1

ENVIRONMENT & ENVIRONMENTAL PROTECTION:

Basics of environment: Introduction & definition to Environment, objectives and guiding principles of environmental education, Components of environment, Structure of atmosphere, Sustainable environment/Development, Impact of technology on the environment in terms of modern agricultural practices and industrialization, Environmental Impact Assessment.

Environmental protection: Role of Government - Assignments of MOEF, Functions of central and state boards, Institutions in Environment and People in Environment,Environmental Legislations, Initiative and Role of Non-government organizations in India and world.

UNIT – 2

Environmental pollution, degradation & Waste management:

Environmental Pollution: Definition, sources and types, Pollutant-Definition & classification, Concepts of air pollution, water pollution, Soil pollution, Automobile Pollution-Causes, Effects & control measures.
Environmental degradation: Introduction, Global warming and greenhouse effect, Acid rain-formation & effects, Ozone depletion in stratosphere and its effect.
Waste management: Municipal solid waste, Biomedical waste and Electr
onic waste (E-Waste).

UNIT – 3

Energy & Natural resources:
Energy: Definition, classification of energy resources, electromagnetic radiation-features and applications, Conventional/Non-renewable sources – Fossil fuels based (Coal, petroleum & natural gas), nuclear energy, Non-conventional/renewable sources – Solar, wind, hydro, biogas, biomass, geothermal, ocean thermal energy, Hydrogen as an alternative as a future source of energy.
Natural resources:
Water resource - Global water resource distribution, Water conservation methods, Water quality parameters, Uses of water and its importance.
Mineral resources - Types of minerals, Methods of mining & impacts of mining activities.Forest wealth - Importances, Deforestation-Causes, effects and controlling measures

UNIT – 4

Ecology, ecosystem & field work:
Ecology-Definition, branches, objectives and classification, Concept of an ecosystem – Structure and functions, Characteristics of an Ecosystem - Ecosystem Resilience, Ecological succession and productivity, Balanced ecosystem, Components of ecosystem-abiotic and biotic, biological diversity.
Biogeochemical cycles and its environmental significance – Carbon and nitrogen cycle, Energy flow in ecosystem, food chains –types, food web & Ecological Pyramids.

TEXTBOOKS:

1. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, Co-authored &Customised by Dr.MS Reddy & Chandrashekar, REVA University, 1st Edition, 2017.
2. R.J. Ranjit Daniels and Jagadish Krishnaswamy, "Environmental Studies", Wiley India Private Ltd., New Delhi, 2nd Edition, 2014.
3. Benny Joseph, "Environmental Studies", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2nd Edition, 2008.
4. Dr.S.M.Prakash, "Environmental Studies", Elite Publishers, Mangalore, 2nd Edition, 2009.

REFERENCEBOOKS:

1. Rajagopalan R, "Environmental Studies – from Crisis to cure", Oxford University Press, New Delhi, 3rd Edition, 2016.
2. Anil Kumar Dey and Arnab Kumar Dey, "Environmental Studies", New age international private limited publishers, New Delhi, 2nd Edition, 2007.
3. Michael Allaby, "Basics of environmental Science", Routledge-Tayler & Francis e-library, New York, 2nd Edition, 2002.
4. Dr.Y.K Singh, "Environmental Science", New age international private limited publishers, New Delhi, 1st Edition, 2006.

Self-LearningExercises: Need for public awareness on the environment, Gaia Hypothesis

Course Title	ADVANCED KANNADA (or) Basics of Kannada	Course Type	Theory

Course Code	B20AHM301 & B20AHM301	Credits	0		Class		III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	-	-	-	-	-	-	-

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡಿಗರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಪರಿವಿಡಿ

ಘಟಕ – 1 : **ಕವಿತೆಗಳು**

1. ಬೆಳಗು – ದ ರಾ ಬೇಂದ್ರೆ
2. ಕಲ್ಕಿ – ಕುವೆಂಪು

ಘಟಕ – 2 : **ಕಥೆಗಳು**

3. ಗಾಂಧಿ – ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ
4. ಸೆರೆ – ಯಶವಂತ ಚಿತ್ತಾಲ

ಘಟಕ – 3 : **ವಿಜ್ಞಾನ ಲೇಖನಗಳು**

5. ಆನೆಹಳ್ಳದಲ್ಲಿ ಹುಡುಗಿಯರು – ಬಿ ಜಿ ಎಲ್ ಸ್ವಾಮಿ
6. ವೃತ್ತಿಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಮಾಧ್ಯಮ – ಎಸ್ ಸುಂದರ್

ಘಟಕ – 4 : ಪರಿಸರ ಲೇಖನಗಳು

7. ಚೀಂಕ್ರ ಮೇಸ್ತ್ರಿ ಮತ್ತು ಅರಿಸ್ಟಾಟಲ್ – ಕೆ ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
8. ಗುಬ್ಬಚ್ಚಿಯ ಗೂಡು – ಪಿ ಲಂಕೇಶ್

- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡಿಗರಿಗೆ **'ಕನ್ನಡ ಕಲಿ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಕನ್ನಡಿಗರಿಗೆ **'ಸಾಹಿತ್ಯ ಸಿಂಚನ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡಿಗರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ

ಹಲವಾರು ಪಠ್ಯಪುಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

REVA UNIVERSITY
Bengaluru, India

ರುಕ್ಮಿಣಿ ಜ್ಞಾನವನ, ಕಟ್ಟಿಗೇನಹಳ್ಳಿ, ಯಲಹಂಕ, ಬೆಂಗಳೂರು – 560064

ಕನ್ನಡೇತರರಿಗೆ ಇಂಜಿನಿಯರಿಂಗ್ ಪ್ರಥಮ ಪದವಿ ಪಠ್ಯ

ಭಾಷಾ ಕೌಶಲ್ಯಗಳು

ಘಟಕ – 1

1. ಆಲಿಸುವುದು

- ಆಲಿಸುವ ಕೌಶಲ್ಯ
- ಆಲಿಸುವಿಕೆಯಲ್ಲಿನ ದೋಷಗಳು
- ಉತ್ತಮ ಆಲಿಸುವಿಕೆ

ಘಟಕ – 2

2. ಮಾತನಾಡುವುದು

- ಸಂಭಾಷಣೆ
- ವ್ಯವಹಾರಿಕ ಸಂಭಾಷಣೆ
- ದೋಷಗಳು ಮತ್ತು ಪರಿಹಾರಗಳು

ಘಟಕ – 3

3. ಓದುವುದು

- ಓದು ಕಲಿಸುವಾಗ ಗಮನಿಸಬೇಕಾದ ಅಂಶಗಳು
- ಧ್ವನ್ಯಾಂಗಗಳ ಪರಿಚಯ
- ಓದಿನ ವಿಧಗಳು

ಘಟಕ – 4

4. ಬರೆಯುವುದು

- ವರ್ಣಮಾಲೆಯ ಸ್ವರೂಪ
- ಕಾಗುಣಿತ ಸ್ವರೂಪ
- ಕನ್ನಡ ಸಂಖ್ಯೆಗಳು

- ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ ಕನ್ನಡೇತರರಿಗೆ **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಬಿ ಎಂ ಎಸ್ ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ, ಬೆಂಗಳೂರು ಕನ್ನಡೇತರರಿಗೆ **'ಕನ್ನಡ ಮನಸ್ಸು'** ಪಠ್ಯ ಪುಸ್ತಕ
- ಕರ್ನಾಟಕ ತಾಂತ್ರಿಕ ಶಿಕ್ಷಣ ವಿಭಾಗ ಇವರು **'ಬಳಕೆ ಕನ್ನಡ'** ಪಠ್ಯ ಪುಸ್ತಕ ತಂದಿದ್ದಾರೆ.

ಹಲವಾರು ಪಠ್ಯಪುಸ್ತಕಗಳು ಇಂಜಿನಿಯರಿಂಗ್ ವಿಭಾಗದಲ್ಲಿ ಕನ್ನಡ ಬೋಧನೆಗೆ ಬಳಕೆಯಲ್ಲಿದ್ದು ಜೊತೆಗೆ ಬಿಎಡ್ ಕನ್ನಡ ಕಲಿಕೆಯ ಪಠ್ಯಪುಸ್ತಕಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ರೇವಾ ವಿಶ್ವವಿದ್ಯಾಲಯದ ತಾಂತ್ರಿಕ ವಿಭಾಗದ ಕನ್ನಡಿಗರು ಮತ್ತು ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ಇಷ್ಟವಾಗುವ ಮತ್ತು ಪ್ರಯೋಜನಕಾರಿಯಾಗುವ ಪಠ್ಯ ಪುಸ್ತಕವನ್ನು ತರಗತಿಗಳು ಪ್ರಾರಂಭವಾಗುವುದರ ಒಳಗೆ ಸಿದ್ಧಪಡಿಸಲಾಗುವುದು.

Detailed Syllabus

Semester-4

Course Title	Design and Analysis of Algorithm				Course Type		Theory	
Course Code	B20CI0401	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

In this course the study of fundamental algorithms to solve a variety of problems, including sorting, searching and graph algorithms are discussed. Techniques for analyzing time and space complexity of algorithms are discussed and hence evaluation of tradeoffs between different algorithms is done.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the mathematical foundation for the analysis of algorithms.
2. Illustrate the algorithms using brute force and divide and conquer design technique.
3. Make use of greedy and dynamic algorithmic design techniques for a given problem.
4. Discuss the problems based on backtracking and branch and bound techniques.

COURSE OUTCOMES (COs):

After the completion o f the course, the student will be able to:

CO#	Course Outcomes	POs	PSOs
CO1	Apply the knowledge of mathematical foundation for the analysis of algorithms.	1 to 5, 12	1,2
CO2	Develop a program to solve the given real world problems using brute force and divide and conquer design paradigm.	1 to 5,12	1,2
CO3	Make use of greedy and dynamic programming techniques for solving the given real world problem.	1 to 5,12	1,2,3
CO4	Utilize backtracking and branch and bound techniques to solve real world problems.	1,to 5,12	1,2,3
CO5	Learn new tools and technologies in the Desiging of algorithms and apply for suitable application development.	12	1
CO6	Develop solution to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,12	1,2

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

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

COURSE CONTENT

THEORY:

UNIT – 1

Introduction-Notion of an Algorithm; Fundamentals of Algorithmic Problem Solving; Fundamentals of the Analysis of Algorithm Efficiency- The Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive Algorithms, Mathematical Analysis of Recursive Algorithms.

UNIT – 2

Brute Force: Bubble Sort, Selection Sort, Sequential Search and Brute-Force String Matching, Exhaustive Search, Depth-First Search and Breadth-First Search, Divide-and-Conquer: Merge sort, Quick sort, Multiplication of Large Integers, Decrease-and-Conquer- Insertion Sort, Topological Sorting.

UNIT – 3

Greedy Technique-Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm Dynamic Programming-Fibonacci numbers, Binomial coefficient, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms

UNIT – 4

Space and Time Trade-Offs- Sorting by Counting, Input Enhancement in String Matching,, Coping with the Limitations of Algorithm Power- Backtracking-n-Queens Problem, Subset-Sum Problem, Branch-and-Bound, Assignment Problem, Travelling Salesman Problem

TEXTBOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson, 3rd Edition, 2012.
2. Ellis Horowitz, Satraj Sahni and Rajasekaran,"Computer Algorithms/C++", Universities Press, 2nd Edition, 2014.
3. Kleinberg, "Algorithm Design", Pearson Education, 1st Edition, 2013.
4. Michael Goodrich, Roberto Tamassia, "Algorithm Design and Applications", Wiley Publishers, 1st Edition, 2014.

REFERENCEBOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, "Introduction to Algorithms", PHI, 3rd Edition,
2. ACM Transactions on Algorithms.
3. ACM Journal of Algorithms and Computational Technology.

JOURNALS/MAGAZINES

1. https://www.mdpi.com/journal/algorithms
2. https://ieeexplore.ieee.org
3. https://www.springer.com/journal/453
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
3. https://www.edx.org/course/algorithm-design-and-analysis

Self-LearningExercises:

1. More exploration on GIThub

List of lab experiments:

Exp. No	PROBLEM STATEMENT
1	Search for a given pattern in a text string using Brute Force String Matching.
2	Sort a set of elements in ascending order using Quick Sort algorithm.
3	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's
4	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithms. Differentiate the methods.
5	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra's algorithm
6	Design and Implement 0/1 Knapsack problem using Dynamic Programming.
7	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm
8	Obtain the DFS ordering of vertices in a given digraph.
9	Implement Horspool's algorithm for String Matching and find the number of key comparisons in successful search and unsuccessful search
10	Sort a given set of elements in ascending order which has duplicate entries. Use the sorting by counting algorithm
11	Implement N Queen's problem using Back Tracking.
12	Write a program to sort all transactions of Big Mall by quantity of sales.
13	Write a program to find network of people of same location in Linkedin social network

Course Title	Device Driver Programming				Course Type		Theory	
Course Code	B20EK0401	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**		**50**	**50**

COURSE OVERVIEW:

This course explains the internal organization and design of kernel modules and device drivers. This course enables the student to design and implement hardware interfacing of Linux systems and provides an improved concurrent programming skill for configuration, compilation and installation of Linux kernel from sources

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Design and implement a kernel module and device driver
2. Implementation of hardware interfacing of embedded system
3. Understand how to compile and load drivers, debug driver, and addition of devices etc

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design and describe the embedded Linux Kernel, Device Driver and Device Driver Modules.	1,2,3,9	1,2,3
CO2	Innovate design, analysis, and Implementation of hardware interfacing of embedded systems for Linux or Android platforms will be discussed	1,2,3,9	1,2,3
CO3	To implement race condition and concurrent programming.	1,2,3,9	1,2,3
CO4	To Configure, compile, and install a Linux kernel/kernel module from sources	1,2,3,9	1,2,3
CO5	Understandability in continuous learning with evolving technological development.	10,12	2,3
CO6	Apply various modules for solving future techniques using continuous learning in the field of device driver modules.	11,12	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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2						1				2	2	3
CO2	3	2	1						1				3	1	3
CO3	4	1	2						1				3	2	1
CO4	3	2	1						1				3	2	1
CO5	3		1							2		2		2	2
CO6	3	2	1								2	2		2	2

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

COURSE CONTENT

THEORY:

UNIT-1 **Fundamental Programming Structures:** Dissecting the "Hello, World" Program; Compiling and Running a Java Program; Primitive Types; Variables; Arithmetic Operations; Strings; Input and Output; Control Flow; Arrays; Functional Decomposition.
UNIT-2 **Character Drivers**: Char Driver Basics, Device Example: System CMOS, Sensing Data Availability, Talking to the Parallel Port, RTC Subsystem, Pseudo Char Drivers, Misc Drivers, Character Caveats
UNIT-3

Serial Drivers UART Drivers, TTY Drivers, Input Drivers, Input Event Drivers, Input Device Drivers, Universal Serial Bus, USB Architecture,Linux-USB Subsystem, Driver Data Structures, **Enumeration Device Example:** Telemetry Card, Class Drivers, Gadget Drivers, Debugging Video Drivers, audio drivers.
UNIT-4 **Network driver:** Ethernet, Asynchronous Transfer Mode, Network Throughput, Debugging Device Drivers ,Kernel Debuggers, Kernel Probes ,Kexec and Kdump, Profiling, Tracing

TEXTBOOKS:

1. SreekrishnanVenkateshwaran, “Essential Linux Device Driver”, Prentice Hall, 2008

REFERENCE BOOKS:

1. Jonathan Corbet, Alessandro Rubini and Greg Kroah-Hatman, “Linux Device Drivers”, 3rd edition. Oreilly, 2005.
2. Robert Love, “Linux system Programming- Talking directly to the kernel and C Library”, O’Reilly Media, Sept 2007.
3. Daniel P. Bovet and Marco Cessti, “Understanding the Linux Kernal”, 3rd Edition. Oreilly, 2000.

JOURNALS/MAGAZINES

1. https://dl.acm.org/doi/10.5555/500771
2. http://https://linux.tips/top-10/list-of-top-linux-magazines
3. https://ieeexplore.ieee.org/document/1625675
4. https://ieeexplore.ieee.org/document/7100338

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/102/106102132/
2. Coursera- Linux : Device and Drivers
3. Coursera – Drivers and Device interfaces

SELF-LEARNINGEXERCISES:

1. Debugging
2. Real-Time Operating System

Course Title	Unix Operating System				Course Type		Integrated	
Course Code	B20CI0402	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

UNIX operating system provides a practical case of operating systems for the user to understand and master deeply and tangibly the theory and algorithms in operating systems. It gives deeper insights into the hierarchical structure, principles, applications, shells, development, and management of the UNIX operation system multi-dimensionally, systematically and from the elementary to the profound. It makes the user to understand about how UNIX operating system functions.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the history, basics and structure of UNIX Operating System
2. Describe UNIX process concepts and scheduling techniques
3. Illustrate the use of different memory management techniques of UNIX.
4. Describe UNIX kernel, data structures and internal representation of files in UNIX operating system

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Outline the history of UNIX environment and its software architecture.	1,2,5	1,3
CO2	Develop the programs to implement the different process states, attributes and control the process in foreground and background.	1,4,5	1,3
CO3	Compare and analyze the performance of different memory management techniques.	1,4,5	2,3
CO4	Make use of UNIX file types, file structure and file system implementation.	1,2,4, 5	1,3
CO5	Learn new tools and technologies in the Desiging of algorithms and apply for suitable application development.	12	1
CO6	Develop solution to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	1,2

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

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

COURSE CONTENT

THEORY:

UNIT – 1

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

UNIT – 2

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

UNIT – 3

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

UNIT – 4

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

PRACTICE:

No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
Part-A			
1.	a) Execute at least ten UNIX shell commands on the terminal and the use of the shell commands.	Linux OS	Shell commands.
	b) Write a C/C++ program to display the output of any UNIX shell command.	Linux OS	
2.	a) Write a C/C++ program to create a sub process by printing its pid and the main process pid value.	Linux OS	Process Control.
	b) Write a C/C++ program to show the process is an orphan process and print its parent pid value.		
3.	a) Write a C/C++ program that creates a zombie and then calls system to execute the ps command to verify that the process is zombie.	Linux OS	Zombie Process.
	b) Write a C/C++ program to avoid zombie process by forking twice.		
4.	a) Write a C/C++ program that outputs the contents of its Environment list.	Linux OS	Process Control.
	b) Write a C/C++ program to illustrate the race condition.		
5.	a) Write a C/C++ to create hard link and soft link and display the hard link count with other attributes of the created file within the sample code.	Linux OS	File Types and File attributes

	b) Consider the last 100 bytes as a region. Write a C/C++ program to check whether the region is locked or not. If the region is locked, print pid of the process which has locked. If the region is not locked, lock the region with an exclusive lock, read the last 50 bytes and unlock the region.		
6.	a) Write a C/C++ program which demonstrates Interprocess communication between a reader process and a writer process of a FIFO file by using the corresponding API's.	Linux OS	Inter Process Communication.
	b) Write a C/C++ program which demonstrates the signal handler function to handle the signal sent by the process.		UNIX signals.
	Part-B (Mini Project: Bank Management System)		
	Bank System is based on the concept of recording customer's account details. The system contains only the admin section. Here the admin can perform all the tasks like creating an account, deposit and withdraw amount, check balance, view all account holder. It contains the following modules of account creation. 1. Customer Module 2. Transaction Module	Linux OS	Modules of Bank Management System
1	Write a C++ program to create account of a customer of Bank Management System and display the contents.	Linux OS	Create a class bank to create account and display thecontents.
2	Write a C++ program to close or delete an account of a created customer accounts of Bank Management System.	Linux OS	To close an existing account.
3	Write a C++ program to display all account holders of a created customer accounts of Bank Management System.	Linux OS	To display all account holders.
4	Write a C++ program to modify an account of a created customer accounts of Bank Management System.	Linux OS	To modify account and display the contents.
5	Write a C++ program to deposit amount of a created customer account of bank Management System and display the contents	LinuxOS	To deposit amount and display the contents.
6	Write a C++ program to deposit and withdraw amount of a created customer account of bank Management System and display the contents.	Linux OS	To withdraw amount and display the contents.
7	Write a C++ program to check the balance amount of a created customer account of bank Management System and display the contents.	Linux OS	To check balance and display the contents.
8	Write a C++ program to intergrate the above modules scenario and display each module contents.	Linux OS	Complete knowledge of the project.

TEXTBOOKS:

1. Yukun Liu, Yong Yue ,Liwei Guo, “UNIX Operating System: The Development Tutorial via UNIX Kernel Services”, Springer, Higher Education Press, 2011.
2. Maurice J. Bach, “The Design of the UNIX Operating System; Pearson Education”, Prentice Hall of India, 2004.

REFERENCEBOOKS:

1. William Stallings,”Operating Systems: Internals and Design Principles”, Prentice Hall of India, seventh edition 2011.
2. D. M. Dhamdhere,”Operating Systems: A Concept-Based Approach”,Tata McGraw-Hill,2002.
3. Gary J. Nutt,”Operating Systems: A Modern Perspective”, Addison-Wesley, 2011.

JOURNALS/MAGAZINES

1. https://link.springer.com/chapter/10.1007/978-3-030-02619-6_53
2. https://link.springer.com/chapter/10.1007/978-3-642-88049-0_25
3. https://link.springer.com/chapter/10.1007/978-3-642-20432-6_1

SWAYAM/NPTEL/MOOCs:

1. Coursera – The UNIX Workbench
2. Coursera – Practical Introduction to the Command line
3. https://www.edx.org/course/linux-basics-the-command-line-interface
4. https://www.edx.org/course/introduction-to-linux

Self-LearningExercises:

1. Basic Shell commands
2. Usage of vi and gedit text editors
3. UNIX I/O system and redirection
4. C modules interface

Course Title	Database Management System				Course Type		Integrated	
Course Code	B20CI0403	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

This course introduces topics such as conceptual data modeling, relational data model, relational query languages, and relational database design. It helps the students to gain fundamental concepts, techniques and applications in database.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Explain the basics of Database Management System.
2. Demonstrate the use of Relational model and Relational algebra.
3. Illustrate the use of different SQL statements.
4. Discuss the topics such as Database Design and Normalization.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Design conceptual entity relationship diagrams for the real world applications.	1 to 5, 10,12	1,2
CO2	Make use of the concepts of relational algebra to solve queries over database.	1 to 5,12	1,2
CO3	Construct the database for given real world application and solve queries over it using SQL commands.	1 to 5,12	1,2,3
CO4	Develop an optimized database using design guidelines and normalization technique.	1,to 5,12	1,2
CO5	Learn new tools and technologies in DBMS and apply for suitable application development.	12	1
CO6	Develop solutions and create better database, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	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	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2					1		1	3	3	
CO2	3	3	2	3	1							1	3	3	
CO3	3	3	2	3	3							1	3	3	3
CO4	3	3	2	3	1							1	3	3	
CO5												3	2		
CO6					2				3	2			3	3	

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

COURSE CONTENT

THEORY:

UNIT – 1

Introduction to databases and Conceptual Modelling: Introduction to database, characteristics of the database approach, data models, schemas, instances, database languages and interfaces, Using high-level conceptual data models for database design, a sample database application, entity types, attributes, keys, relationship types, weak entity types, ER diagrams, naming conventions, design issues. Introduction to various database tools and framework (commercial and open source)

UNIT – 2

Relational Data Model and Relational algebra: Relational model concepts, relational model constraints and relational database schemas, update operations, transactions, dealing with constraint violations, unary relational operations, select and project, relational algebra operations from set theory, binary relational operations, join and division, additional relational operations, examples of queries in relational algebra.

UNIT – 3

SQL: SQL data definition and data types, specifying constraints in SQL, basic retrieval queries in SQL, insert, delete, update statements in SQL, additional features of SQL, schema change statements in SQL, Retrieving data using the SQL Select Statement, Restricting and sorting data, Using Single row functions, Joins, More complex SQL retrieval queries, views in SQL.

UNIT – 4

Database Design Theory and Normalization: Informal design guidelines for relation schemas, Functional dependencies, and Normal forms based on primary keys, General definitions of second and third normal forms, Other Normal forms.

PRACTICE:

S.No	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	Part-A		
1	Consider the following schema for Order Database: SALESMAN (Salesman_id, Name, City, Commission) CUSTOMER (Customer_id, Cust_Name, City, Grade, Salesman_id) ORDERS (Ord_No, Purchase_Amt, Ord_Date, Customer_id, Salesman_id) Write SQL queries to 1. Count the customers with grades above Bangalore's average. 2. Find the name and numbers of all salesmen who had more than one customer. 3. List all salesmen and indicate those who have and don't have customers in their cities (Use UNION operation.) 4. Create a view that finds the salesman who has the customer with the highest order of a day. 5. Demonstrate the DELETE operation by removing salesman with id 1000. All his orders must also be deleted	SQL PLUS	Solving queries using SQL
2	Specify the following queries on the Flight relational database schema using SQL Flights(*flno:* integer, *from:* string, *to:* string, *distance:* integer, *departs:* time, *arrives:* time) Aircraft(*aid:* integer, *aname:* string, *cruisingrange:* integer) Certified(*eid:* integer, *aid:* integer) Employees(*eid:* integer, *ename:* string, *salary:* integer) 1.Find the eids of pilots certified for some Boeing aircraft. 2. Find the names of pilots certified for some Boeing aircraft. 3. Find the aids of all aircraft that can be used on non-stop flights from Bonn to Madras. 4. Identify the flights that can be piloted by every pilot whose salary is more than $100,000. 5. Find the names of pilots who can operate planes with a range greater than 3,000 miles but are not certified on any Boeing aircraft. 6. Find the eids of employees who make the highest salary. 7. Find the eids of employees who make the second highest salary.	SQL PLUS	Solving queries using SQL

3	Solve the below queries by using SQL Student(snum, sname, major, level, age) Class(cname, meets at, room, fid) Enrolled(snum, cname) Faculty(fid, fname, deptid) The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class. Queries 1. Find the names of all juniors (Level = JR) who are enrolled in a class taught by I. Teacher. 2. Find the age of the oldest student who is either a History major or is enrolled in a course taught by I. Teacher. 3. Find the names of all classes that either meet in room R128 or have five or more students enrolled. 4. Find the names of all students who are enrolled in two classes that meet at the same time. 5. Find the names of faculty members who teach in every room in which some class is taught. 6. Find the names of faculty members for whom the combined enrollment of the courses that they teach is less than five. 7. Print the Level and the average age of students for that Level, for each Level. 8. Print the Level and the average age of students for that Level, for all Levels except JR. 9. Find the names of students who are enrolled in the maximum number of classes. 10. Find the names of students who are not enrolled in any class.	SQL PLUS	Solving queries using SQL

4	Solve the below queries by using SQL branch (branch-name, branch-city, assets) customer (customer-name, customer-street, customer-city) account (account-number, branch-name, balance) loan (loan-number, branch-name, amount) depositor (customer-name, account-number) borrower (customer-name, loan-number) employee (employee-name, branch-name, salary) 1. Find the names of all customers. 2. Find the names of all branches in the loan relation, don't display duplicates. 3. Display the entire Branch table. 4. Find the account number for all accounts where the balance is greater than $700. 5. Find the account number and balance for all accounts from Brighton where the balance is greater than $800. 6. Display the branch name and assets from all branches in thousands of dollars and rename the assets column to 'assets in thousands'. 7. Find the name of all branches with assets between one and four million dollars. 8. Find the name, account number, and balance of all customers who have an account. 9. Find the name, account number, and balance of all customers who have an account with a balance of $400 or less.	SQL PLUS	Solving queries using SQL
5	Consider the following schema for a Library Database: BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of_Copies) BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) Write SQL queries to 1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc. 2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017 3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. 4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query. 5. Create a view of all books and its number of copies that are currently available in the Library.	SQL PLUS	Solving queries using SQL

TEXTBOOKS:

1. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Education, 5th Edition, 2007.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw-Hill, 3rd Edition, 2003.
3. Phill Pratt, "Concepts of Database Management, Cengage Learning", 8th Edition, 2014
4. Jeffrey A Hoffer, "Modern Database Management, Pearson", 12th Edition, 2015

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. C J Date, "Database Design and Relational Theory: Normal Forms and All that Jazz", O 'Reilly, April 2012.

3. James Martin, “Principles of Database Management Systems”, 1985, Prentice Hall of India, New Delhi
4. IEEE Transactions on Knowledge and Data Engineering
5. Elsevier Data and Knowledge Engineering
6. ACM Transactions on Database Systems

JOURNALS/MAGAZINES

1. http://www.ijstr.org/final-print/june2019/Database-Management-System.pdf
2. https://www.dbjournal.ro/

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/courses?query=database%20management
2. https://onlinecourses.swayam2.ac.in/cec19_cs05/preview
3. https://www.edx.org/learn/databases
4. https://www.classcentral.com/course/swayam-data-base-management-system-9914

Self-Learning Exercises:

1. MONGODB
2. Transaction and concurrency control
3. UML

Course Title	Microprocessors and Interfacing				Course Type		Integrated	
Course Code	B20EK0402	Credits	4		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**4**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course describes the architecture, programming and interfacing of 8086 Microprocessor. It helps the student in building simple assembly language programs for 8086 Microprocessor. It also gives instruction to advanced microprocessors, GPUs and DSPs.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the architecture, pin configuration of various microprocessors and Interfacing ICs,
2. Identify various addressing modes.
3. Illustrate 8086 assembly language Interrupt based real time applications.
4. Discuss 8086 programmingforinterfacingperipheraldevicesforcontrolapplications.
5. Describe the architecture of various advanced microprocessors.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the suitable addressing modes and instructions formats of 8086 architecture to develop program for the given real world problem.	1,2,3,4,5	1
CO2	Make use of addressing modes and instructions formats of 8086 architecture	1,2,3,4,5	1,2
CO3	Develop 8086 program to interface peripheral devices for control applications.	1,2,3,4,5	2
CO4	Compare the architecture of various advanced microprocessors.	1,2,3,4,5	1
CO5	Learn new tools and technologies in the microprocessor and interfacing and apply for suitable application development.	12	1
CO6	Develop solutions in the microprocessors and interfacing to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,4,2	1,2

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

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

COURSE CONTENT

THEORY:

UNIT-1

Intel 8086 Microprocessor: Architecture of 8086, Register organization, Signal description, Physical memory organization, General bus operation, Input/output addressing capability, Special processor activities, Minimum and Maximum mode of 8086 system and timings.8086 Machine language Instructions: instruction formats, Addressing modes - Register, Immediate, Direct, Register indirect, Base plus index, Register relative and Base relative plus index addressing modes. Assembler directives -Symbols, variables, constants, different typesof directives, Introduction to IDE and MASMa Assembler Programming examples on debugging.

UNIT-2

Instruction Set Of 8086 Microprocessor: Data transfer instructions, Arithmetic and logical instructions, conditional and unconditional branch instructions, String instructions, Looping instructions, Machine control instructions, Shift and rotate instructions, Assembly language programming. Introduction to stack, Stack structure of 8086, Interrupts and interrupt service routines, Interrupt cycle of 8086, Non-maskable interrupt, Maskable interrupt (INTR).Interrupt programming, Timing and delays, Macros.

UNIT-3

Peripherals And Their Interfacing With 8086: Static and dynamic RAM interfacing, Input and output ports Interfacing, Stepper motor Interfacing, Interfacing of Analog to digital converter and Digital to analog converter. Programmable Input-Output Port 8255 (PPI): Modes of operation of 8255, Key board and display interfacing, Control of high power devices using 8255, programming examples.

UNIT-4

Introduction to Advanced Microprocessors: Introduction to Intel Microprocessors - 80186, 80286, 80386, 80486, Pentium, Pentium-II, Pentium-IV, Xeon. Overview of Architecture, Programming and Interfacing of these processors. Introduction to Kiel Software, Multicore programming, GPUs, SGX and DSP processors.

TEXTBOOKS:

1. A.K Ray and K.M. Bhurchandi," Advanced Microprocessor and Peripherals",Tata McGraw Hill, 2007.
2. K.R. Venugopal and Rajakumar, "Microprocessor X86 Programming", BPB Publications, 2003.

REFERENCEBOOKS:

1. Yu Cheng Liu & Glenn A Gibson, "Microcomputer systems 8086/8088 family, Architecture, Programming and Design -2nd Edition", Prentice Hall of India, 2003.
2. Douglas V Hall, "Microprocessor and Interfacing, Programming & Hardware", 2nd Edition, Penram International, 2006.
3. Barry. B. Bray, "The Intel Microprocessor - 4th Edition", Prentice Hall of India, 1997.
4. Springer Lecture notes in Electrical engineering -Embedded Microcontroller Interfacing.
5. Elsevier Journal of Microprocessors and Interfacing.

JOURNALS/MAGAZINES

1. https://dl.acm.org/doi/abs/10.5555/374824.374733
2. https://www.journals.elsevier.com/microprocessors-and-microsystems
3. https://ieeexplore.ieee.org/document/1213024

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ee41/preview
2. https://www.mooc-list.com/tags/microprocessors
3. Real time embedded systems -Coursera

SELF-LEARNINGEXERCISES:

Coding and decoding of 8086 instructions set with some examples, Explore Complete Instructions set of 8086 Microprocessor in de

Course Title	Numerical Methods and Optimization Techniques				Course Type		Theory	
Course Code	B20AS0401	Credits	3		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50%**	**50%**

COURSE OVERVIEW:

Numerical Methods and Optimization Techniques emphasizes on the development of numerical algorithms to provide solutions to common problems formulated in science and engineering. The primary objective of the course is to develop the basic understanding of the construction of numerical algorithms, and perhaps more importantly, the applicability and limits of their appropriate use. The emphasis of the course will be the thorough study of numerical algorithms to understand the guaranteed accuracy that various methods provide, the efficiency and scalability for large scale systems. and issues of stability. Optimization Techniques provide ability to solve real-world problems by finding the optimal solutions to the models subject to constraints.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain numerical methods to obtain approximate solutions to mathematical problems.
2. Examine numerical methods for various mathematical operations and tasks, such as interpolation and integration.
3. Illustrate the notation of vector spaces, sub spaces, linear independence, coordinate and change of coordinate.
4. Solve linear programming problems considering Transportation and Assignment Problems.

COURSE OUTCOMES (COs):

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply numerical methods to obtain approximate solutions for mathematical problems.	1 to 3, 12	1
CO2	Determine suitable interpolation formula and quadrature formulae to find the solution for the given data.	1 to 4 ,12	2
CO3	Solve the matrix associated with liner transformation with respect to the given base and understand the relationship between the operation and linear transformations and their corresponding matrices.	1 to 5,	3
CO4	Develop mathematical equations with simplex method and Transportation-Assignment problem for linear programming	1 to 5,12	1,2,3
CO5	Learn new tools and technologies in the Numerical Methods and apply for suitable application development.	12	
CO6	Develop solutions in the Numerical Methods to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,10	

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

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

COURSE CONTENT

THEORY:

UNIT – 1

Numerical Methods: Errors in Numerical Calculations Types of Errors-Significant Digits-Programming Errors-Numerical Solution of Non-Linear Equations-Bisection Method-Regula Falsi Method-Newton Raphson Method –Fixed Point Method of Iteration – Rates of Convergence of These Methods. Solutions of Algebraic Equations, Relaxation Method and Gauss Seidel Iteration Method.

UNIT – 2

Numerical Analysis: Finite Differences-Operators (Δ, ∇ and E), Interpolation, Newton-Gregory Forward Interpolation Formula, Central Difference, Stirling And Bessel's Interpolation Formulae, Lagrange's Interpolation Formula, Inverse Interpolation Formula, Divided Difference Formula, and Newton's Divided Differences Formula**.** Numerical integration**:**Newton-Cotes quadrature formulae: Trapezoidal, Simpson's rules and Weddle's rule.

UNIT – 3

Vector Spaces and Linear transformations: Bases, Echelon forms, Rank, and determinants. Gauss elimination and its complexity, Inner products, Gram-Schmidt orthogonalization. Linear transformations.

UNIT – 4

Linear Programming: Introduction, Canonical and Standard Form of LPP-Simplex Method-Big M Method- Two Phase Method-Principle of duality-Dual Simplex Method. Transportation Problem and Assignment problem.

TEXTBOOKS:

1. Sastry S.S., "Numerical Analysis", Prentice-Hall India (module I), 4th edition
2. K. Hoffman and R. Kunze," Linear Algebra", Prentice-Hall India, 1971.
3. R Panneerselvam," Operations research", 2nd edition, PHI

REFERENCES

1. KanthiSwarup, P.K. Gupta, Man Mohan, "Operations research", Sultan Chand & Sons. (module II), 5th edition.
2. Froberg, "Introduction to Numerical Analysis", Second Edition, Addition Wesley
3. Gerald and Wheatley, "Applied Numerical Analysis", Pearson Education Asia, Sixth Edition
4. S.S Rao, "Optimization Theory and Applications", Wiley Eastern
5. Grawin W. W, "Introduction of Linear Programming", McGraw Hill.
6. M. K. Jain, S. R. K. Iyengar and R. K. Jain, "Numerical Methods for Scientific and Engineering Computation", New Age International Publishers, 6th edition, 2012.

JOURNALS/MAGAZINES

1. https://onlinelibrary.wiley.com/journal/10970207
2. https://www.springer.com/journal/245
3. https://ijnao.um.ac.ir/
4. https://www.scimagojr.com/journalrank.php?category=2612

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/108/106108056/
2. https://www.coursera.org/learn/intro-to-numerical-analysis
3. https://nptel.ac.in/courses/122/102/122102009/
4. https://nptel.ac.in/courses/122/106/122106033/
5. https://www.edx.org/course/convex-optimization

Self-LearningExercises:

1. Optimization Methods for Business Analytics
2. Numerical Methods and Optimization in Finance

Course Title	Communication Skills				Course Type		Theory	
Course Code	B20AH0301	Credits	2		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	2	2	2	26	0	50%	50%

COURSE OVERVIEW

This course is aimed to develop basic communication skills in English in the learners, to prioritize listening and reading skills among learners,to simplify writing skills needed for academic as well as work place context, to examine that the learners use the electronic media such as internet and supplement the learning materials used in the classroom.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Develop basic communication skills in English.
2. EmphasizeonthedevelopmentofspeakingskillsamongstlearnersofEngineeringandTechnology
3. Impart the knowledge about use of electronic media such as internet and supplement the learning materials used in the classroom.
4. Inculcatethehabitofreadingandwritingleadingtoeffectiveandefficientcommunication.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate speaking ability with clarity, confidence and comprehension and communicate with one or many listeners using appropriate communicative strategies (SpeakingSkills).	1 to 3, 12	1,3
CO2	Build inferences from the text.	1 to 4 ,12	2
CO3	Make use of accurate writing skills using different components of academic writing.	1 to 5,12	2

CO4	Develop the ability to write cohesively, coherently and flawlessly avoiding grammatical errors, using a wider vocabulary range, organizing their ideaslogic ally on a topic	1 to 5,12	2,3
CO5	Learn new tools and technologies in the numerical methods and optimization and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the numerical methods and optimization to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level					
CO#	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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		1
CO2	3	3	3	3								1		3	
CO3	3	3	3	3	3							1		2	
CO4	3	3	3	3	3							1		3	3
CO5	3		3		3									3	
CO6	3	3		3									3		3

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

COURSE CONTENT

THEORY:

UNIT-1

FunctionalEnglish: Grammar:Prepositions;ModalAuxiliaries, Reading Comprehension, Activeandpassivevoice, Giving Instructions

UNIT-2

Interpersonal Skills: Grammar: Tenses; Wh-questions, Compound words; Phrasal verbs, Recommendations

UNIT-3

Multitasking Skills Grammar: Conditional Sentences, Homonyms; homophones, Subject-verb agreement

UNIT-4

Communication Skills Grammar: Direct and indirect speech, Interpreting visuamaterials (line graphs, pie charts etc.), Single word substitutes.

TEXTBOOKS:

1. Green,David.ContemporaryEnglishGrammarStructuresandComposition.NewDelhi:MacMillan Publishers,20l0.
2. Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, 20l2.

3.Leech,GeoffreyandJanSvartvik.ACommunicativeGrammarofEnglish.Longman,2003.

REFERENCEBOOKS :

1. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.
2. Rizvi, M. Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill, 2005.
3. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 20ll.
4. Sen et al. Communication and Language Skills. Cambridge University Press, 20l5.

Course Title	Indian Constitution and Professional Ethics				Course Type		Theory	
Course Code	B20LS0301	Credits	2		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**2**	**2**	**2**	**26**	**0**	**50**	**50**

COURSE OVERVIEW

The Constitution of India lays down in defining fundamental political principles, establishes the structure, procedures, powers and duties of government institutions and sets out fundamental rights, directive principles and duties of citizen. It helps to know and understand the human rights and human values. It also helps to know the meaning of ethics and need of ethics in personal and professional life.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basic knowledge required to understand Constitution of India.
2. Describe the Fundamental Rights, Duties and other Rights.
3. Discuss different types of ethics.
4. Explore ethical standards followed by different companies.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Analyze the Fundamental Rights, Duties and other Rights protected under Indian Constitution.	1 ,6,7,8,9, 12	1,3
CO2	Demonstrate the practicality of Constitution perspective and make them face the world as a bonafide citizen.	1 to 4,7,8 ,12	2
CO3	Illustrate the professional ethics and human values.	1 to 5, 7,8 ,12	2
CO4	Summarize ethical standards followed by different companies.	1 to 5,7,8,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2	2	2	2			1	3		1
CO2	3	3	3	3			3	3				1		3	
CO3	3	3	3	3	3		3	3				1		2	3
CO4	3	3	3	3	3		3	3				1		3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

Indian constitution: Sailent features, fundamental rights and duties (Directive principle and statepolicy), Legislature (Loka Sabha &Rajya Sabha), Executive (President& Governor) and Judiciary (Supreme court & high court), Composition and function of parliament, Council of ministers, prime minister, Speaker, Passing of bills.

UNIT – 2

Human Rights: Nature and Scope of human rights, Universal protection of human rights (UDHR),Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups (children, women & old-age).

Human values: Truth, Honesty, Loyalty, Love, Peace with examples, Difference between ethics, beliefs and morals.

UNIT – 3

Ethics: Meaning, Definition, Evolution, Need of ethics, Aristotlean Ethics, Utilitarianism, Katianism, human values(Good conduct, respect for elders), ethical human conduct (Gender equality), Professional Ethics, Personal Ethics and Business Ethics, Ethical Standards, Duties of Employers and Employees.

UNIT – 4

Engineering Ethics: Definition Scope and needs, Ethics in Consumer Protection, Due Care theory, Environmental Ethics, Ethical Code of Conduct in ethics. Best Ethical Companies in India and Abroad; Corporate Social Responsibilities, Code of Conduct and Ethical Excellence

TEXT BOOKS:

1.Kapoor, S.K., "Human rights under International Law and Indian Law", Prentice Hall of India, New Delhi, 2002.

2. Basu, D.D., “Indian Constitution”, Oxford University Press, New Delhi, 2002.

3. Chakraborty, S.K., “Values and ethics for Organizations and Theory Practice”, Oxford University Press, New Delhi, 2001.

REFERENCES BOOKS:

1. Meron Theodor, “Human Rights and International Law Legal Policy Issues”, Vol. 1 and 2, Oxford University, Press, New Delhi, 2000.

2. M V Pylee, “An Introduction to Constitution of India”, S Chand & Company, 5th Edition

3. Durga Das Basu, “Introduction to constitution of India”, LexisNexis, 23rd Edition.

SELF-LEARNINGEXERCISES:

Abuse of Technologies: Hacking and other crimes, addiction to mobile phone usage, video games and social networking websites

Course Title	Universal human values				Course Type		Theory	
Course Code	B20AHM401	Credits	0		Class		IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**0**	**0**	**0**	**0**	**0**	**50%**	**50%**

COURSE OVERVIEW

Universal human valueshelp the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1.Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.

2.Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4.Development of commitment and courage to act

COURSEOUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession	1 to 3, 12	1,3
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	1 to 4 ,12	2
CO3	Understand the role of a human being in ensuring harmony in society and nature.	1 to 5,12	2
CO4	Demonstrate the role of human being in the abetment of pollution	1 to 5,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3									1	3		1
CO2	3	3	3	3								1		3	
CO3	3	3	3	3	3							1		2	3
CO4	3	3	3	3	3							1		3	3

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

COURSE CONTENT

THEORY:

UNIT – 1

Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship, basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly, Method to fulfil human aspirations: understanding and living in harmony at various levels, Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seeker and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

UNIT – 2

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

UNIT – 3

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Include practice

sessions to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology etc.

UNIT – 4

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010
2. A.N Tripathy, Human Values, New Age Intl. Publishers, New Delhi, 2004.
3. R.R. Gaur, R. Sangal and G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2010
4. Bertrand Russell, Human Society in Ethics & Politics, Routledge Publishers, London, 1992

REFERENCE BOOKS:

1. Corliss Lamont, Philosophy of Humanism, Humanist Press, London, 1997
2. I.C. Sharma, Ethical Philosophy of India Nagin & co Julundhar, 1970
3. Mohandas Karamchand Gandhi, The Story of My Experiments with Truth, Navajivan Mudranalaya, Ahmadabad, 1993
4. William Lilly, Introduction to Ethics, Allied Publisher, London, 1955

Detailed Syllabus
Semester -5

Course Title	Web Technology				Course Type		Integrated	
Course Code	B20EJ0501	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	5	3				
	Practice	2	2	2	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**5**	**5**	**3**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

The basics of Web application tools such as HTML, XHTML and CSS are introduced. The course also provides knowledge about advanced research topics such as XML, Perl and PHP.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of HTML code.
2. Illustrate the use of Cascading Style Sheets in web pages.
3. Demonstrate the use of Angular JS, Java Scripts and XML in real world applications.
4. Describe the principles of object oriented development using Perl and PHP.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Experiment with various HTML tags to create a web page for real world applications.	1 ,2,3,4, 8, 9 , 12	1,2
CO2	Make use of Cascading Style Sheets to design a web page for real world applications.	1 ,2,3, 5,9,12	1,2
CO3	Develop client-side environment using Angular JS, Java Scripts and XML for Web based applications.	1,2,3,4 5, 9, 12	1,2
CO4	Create XML documents and Schemas	1,2,3,4,5,9,12	1,2
CO5	Apply object-oriented programming principles using PHP	1,2,3,4,5,9,12	1,2

CO6	Build a server-side environment using PHP and Perl for web-basedapplications.	1,2,3,4,5,6,9,12	1,2

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT- 1
Introduction to HTML, HTML Syntax, Semantic Markup, Structure of HTML Documents, HTML Elements, HTML Semantic Structure Elements, HTML Web Storage. HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Micro formats.

UNIT -2
Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, CSS Text Styling. Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.
UNIT- 3
Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, Caching, JavaScript and jQuery, Angular JS, JavaScript Pseudo-Classes, XML Processing and Web Services, XML Processing, Overview of Web Services.
UNIT- 4
Introduction to Perl and PHP. Arrays and Superglobals, Arrays, GET and POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP

TEXT BOOKS:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education India, 1st Edition, 2016.

2. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 1st Edition, 2006.

3. Robert. W. Sebesta, "Programming the World Wide Web", Pearson Education, 4th Edition, 2007.

REFERENCE BOOKS:

1) Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", O'Reilly Publications, 4th Edition, 2015.

2) Luke Welling, Laura Thomson, "PHP and MySQL Web Development", Pearson Education, 5th Edition 2016.

3) Nicholas C Zakas, "Professional JavaScript for Web Developers", Wrox/Wiley India, 3rd Edition 2012.

4) David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual", O'Reilly/Shroff Publishers & Distributors Pvt Ltd, 1st Edition, 2014.

5) Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", Murachs/Shroff Publishers & Distributors Pvt Ltd, 3rd Edition, 2016.

6) Gerardus Blokdyk, "Representational State Transfer: Practical Integration", CreateSpace Independent Publishing Platform, 1st Edition, 2018.

JOURNALS/MAGAZINES:

1. International Journal of Web Technology-ISSN:2278-2389
2. International Journal of Web & SemanticTechnology(IJWesT)
3. ELSEVIERJournalswithin"InternetAndWebTechnology"

SWAYAM/NPTEL/MOOCS:

1. Coursera – Python for everybody, University of Michigan
2. Coursera – Python Basics, University of Michigan
3. https://nptel.ac.in/courses/106/106/106106182/
4. https://www.edx.org/learn/python

SELF-LEARNING EXCERCISES:

HTML5,JQuery,XML, Ruby, Introduction to REST and RESTful API.

Lab experiments:

Program No: 1

In today's digital world, information dissemination through printed documents consume lot of time. To overcome this drawback it is better to adopt digital technology for information dissemination, like e-journals, e-books, e-advertisements, etc. Information dissemination through Internet in the form of web content is essential and convenient option. Design and develop static web pages for an online Book store. The pages should resemble like www.amazon.com The website should consist of. Home page, Registration & Login, User profile page, Books catalog, Shopping cart, Payment by credit card, and order confirmation.

Program No: 2

Internet or online services works on clients and server model. A client is a web browser through which users make requests, which contain input required, for service from the server to perform tasks. Server is a program running on a dedicated computer. Performance of any service or server depends on its throughput. Server throughput deteriorates when users send more and more invalid requests for service and thus results in wastage of server resources that are very precious. As a solution to this problem design a web page that takes student details such as Name, branch, Semester, University, date of admission, mobile number, email id and check for validity or correctness of the input data by writing a JavaScript to validate these fields.

Program No: 3

Clients interact with servers by sending service requests that contain input required to complete the requested task or service. Input required for requested service may be collected through a web page, that acts as an interface between users and the server, in the form of text fields, text areas, radio buttons, push buttons and so on. Hence it is better to instruct or help clients to input correct data through web page by displaying appropriate error messages or alerts as and when users supply wrong input using event handlers. To demonstrate this task, design and develop a web page using JavaScript, XHTML that collects the SRN (Valid format is: Any letter followed by two digits, followed by two letters then followed by three digits). Include event handler for the form elements that collects information to validate the input. Messages must be produced in the alert windows as and when errors are detected.

Program No: 4

Dynamic web content is the information that is retrieved from one or more web servers depending upon what information client have requested for, and composed in response to users' requests. Advanced web technologies play a vital role in storage, processing and retrieval of dynamic web content from web servers. Hence it is important to use advanced web technologies such as XML to improve the efficiency in data retrieval. Create and save XML document for students information and display the same using cascaded style sheet.

Program No: 5

Information technology has become part and parcel of humanity to such an extent that people can shop anything online, from anywhere, at any time using an electronic device that has access to Internet. This has brought in the concept of virtual stores which provide products at less cost. To improve sales it is mandatory to organize items catalog based on item name, item price, and manufacturer so on. For such online shopping sites, look and feel is an obvious requirement which can be achieved using CSS & XSLT. Design a document using CSS and XSLT to create a catalog of items for an online electronic shopping.

Program No: 6

In any business organization, employees keep traveling across different geographical locations and at the same time they want to be connected to their organization's computing resources such as email server, database server, file server, etc. to retrieve information such as sales details, assigning tasks to employees, and upload inspection site details, so on. Using PHP develop a web page that accepts book information such as ISBN number, title, authors, edition and publisher and store information submitted through web page in MySQL database. Design another web page to search for a book based on book title specified by the user and displays the search results with proper headings.

Program No: 7

Using computers without graphical user interfaces require the knowledge about syntax of computer commands and programming languages, also this makes users to feel that the use of computers is difficult and cumbersome. This impression of users on computers can be changed by providing good and easy-to-use graphical user interfaces which play vital role in use of computer applications or software without worrying about syntax of programming languages or computer commands. In fact computer software with good and easy-to-use graphical user interfaces will have large number of users. a) Design HTML page that takes UNIX command as input in a text field and submit it to a Perl program that executes given command and display the output on the web page b) Write a Perl program to keep track of the number of visitors to a web page and display the count of visitors with proper headings.

Program No: 8

Databases are the storage systems used by most of the business and information technology enterprises as back end. When users generate data using GUI, for ex. personal information, data are sent to back end database for storage and also users can retrieve this data as and when required from the back end (database) to the front GUI. In the real world there are several databases such as Oracle, DB2, MySQL, SQL Server, MS-Access, DBMongo, etc. To illustrate the process of generating data from the front end and store it on back end database then retrieve the available data from the back end database, write a Perl program to read personal information of a person such as first name, last name, age, permanent address and pin code entered by the user into a table created in MySQL. Read the same information from the database and display on the front end.

Program No: 9

Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page.

Course Title	Computer Networks			Course Type	Theory
Course Code	B20CI0501	Credits	4	Class	V semester

Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50%**	**50%**

COURSE OVERVIEW:

Course Description: The main emphasis of this course is on the organization and management of local area networks (LANs). The course description include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and about Open Systems Interconnection (OSI) communication model with TCP/IP protocol; This course provides knowledge of error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. This course also emphasis on User Datagram Protocol, TCP Congestion Control; DNS Message Formatting and Remote Login. Protocols.

COURSE OBJECTIVE:

The main objectives of this course are:

1. Explain the protocol stacks (OSI and TCP/IP) for data communication
2. Discuss the error detection & correction strategies for data transmission.
3. Design the connection establishment of network computing devices.
4. Illustrate the TCP, UDP protocols and explain Domain Name System.

COURSE OUTCOMES(COs)

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

CO#	CourseOutcomes	POs	PSOs
CO1	Make use of the architectural principles of computer networking and compare different approaches to organising networks	1 to 6,12	1,2
CO2	Identify the good network design with simplicity, scalability, performance and the end-to-end principle	1 to 6,12	1,2
CO3	Appraise the working principles of Internet	1 to 6,12	1,2
CO4	Develop applications using network protocols	1 to 6,12	1,2
CO5	Learn new tools and technologies in the Computer Networks and apply for suitable application development.	5,6,9,10	2
CO6	Develop solutions in the Computer Networks to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,6,9,10	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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1						1	3	3	
CO2	3	3	3	3	2	2						1	3	3	
CO3	3	3	3	3	2	1						2	3	3	
CO4	3	3	3	2	2	1						1	3	3	
CO5					2	3			2	3				3	
CO6					2	3			2	3					3

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

COURSE CONTENTTHEORY

Contents
UNIT – 1
Introduction to Data Communication and Networking: Internet history and Internet today, Data Communications, Networks, Network Topologies, Classification of Networks, Protocols & Standards, Introduction to Network Tools-(WireShark, Packet Tracer, NS3, etc), Layered Tasks, The OSI model, Layers in OSI model, TCP/IP Protocol suite, Addressing. Introduction to switching: Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, Physical Layer – Periodic Analog signals, Digital signals, Request bit rate, shanon capacity, performance, PCM, DM, Parallel transmission, serial transmission, ASK, FSK, PSK, QAM, AM, FM, PM.
UNIT-2
Coding: Line Coding and block coding. Multiplexing: FDM, WDM, TDM, FHSS, DSSS. Transmission Media. **Error Detection and Correction**: Introduction, cyclic Codes: Cyclic redundancy code generation. Frames, Packets, Data Link Protocols: HDLC, Point-to-Point Protocol. **MAC Protocols**: classification of MAC protocols, Random access (ALOHA, CSMA/CD, CSMA/CA), Controlled Access (Reservation, Polling, Token passing), Channelization Protocols (FDMA, TDMA, CDMA) **Introduction to Networking Devices**: Digital Subscriber line Modems, Cable modems, Repeaters, Hubs, Bridges, Routers, and High layered switches, Gateways, Virtual LAN.
UNIT – 3
Standards: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet. IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism. Bluetooth Architecture. Introduction to Wireless networks WiFi, WiMAX, 4G, 5G, Satellite networks, MPLS,VPN, ATM. **Network Layer**: IPv4 addresses, IP Datagram format, ICMP Messages, Mobile IP, IPv6 addresses, IPv6 Packet Format, Transition from IPv4 to IPv6, Routing algorithms (Distance Vector, Link State and Path vector), Unicast Routing protocols(RIP, OSPF), Introduction to BGP, Introduction to Multicasting protocols, brief introduction to multicast protocols such DVMRP, MOSPF, PIM, IGMP.
UNIT – 4
Transport Layer: Introduction to GoBack-N, Selective repeat N, Piggybacking. Services and port numbers, User Datagram Protocol (UDP): UDP Segment, Transmission Control. Protocol (TCP): TCP Segment, TCP Connection Set up, Application of TCP and UDP. TCP flow control, TCP error control, TCP Congestion Control and options. Introduction to SCTP services and features. **Application Layer**: Client server programming using UDP and TCP, Name/Address Mapping, DNS Message Format.

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

1	a) Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.	RJ-45 connector, IO Connector, Crimping Tool, Twisted pair Cable, Cable Tester.	Cable Crimping, Standard Cabling and Cross Cabling, IO connector crimping and testing the crimped cable using a cable tester can be done successfully
	b) Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.	NIC, Adapter	Installation and configuration of Wired and Wireless (remotely) NIC and transfer files between systems in LAN and Wireless LAN between two systems in a LAN can be done successfully.
	c) Install and configure Network Devices: HUB, Switch and Routers.	HUB, Switch, Router and configuration software.	Gain the knowledge on configuring the different connecting devices
	d) Connect the computers in Local Area Network.	Computer Systems with connecting media.	Interconnection and building a simple LAN
2	a) Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.	Computer Systems with connecting media.	Configuration of peer to peer network communication
	b) Configure Internet connection and use IPCONFIG, PING / Tracer and Net stat utilities to debug the network issues.	Connected Computer Systems.	Configure Internet connection
	c) Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network	Connected Computer Systems with printer.	File *t*ransfer between systems in LAN using FTP Configuration.
	d) Study of basic network command and Network configuration commands	Command Prompt	Network configuration
3	In information theory and coding theory with applications in computer science and telecommunication, error detection and correction or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from thesource to a receiver. Error detection techniques allow detecting such errors, while	CRC Hamming Code	Error detection and control in data transmission.

	error correction enables reconstruction of the original data in many cases. Write a Program for Implementation of any one mechanism for Error Detection / Error Correction Techniques.		
4	A routing algorithm is a procedure that lays down the route or path to transfer datapackets from source to the destination. They help in directing Internet traffic efficiently. ... Routing algorithm mathematically computes the best path, i.e. "least – cost path" that the packet can be routed through Write a Program for Implementation of any routing algorithms.	Distance vector & Link state routing	Routing in networks before the communication begins.
Part B: Mini Project 1: Design of Corporate Network			
1	Configuring a Switched network and Study of VLAN's and assigning a PC based on the VLAN.	Windows/Linux OS, Packet Tracer	Switch and VLAN Configuration.
2	Implementing an IP Addressing Scheme Configuring WEP on a Wireless Router. Interpreting Ping and Traceroute Output	Windows/Linux OS, Packet Tracer	Router configuration and connectivity checking.
3	Configuring Static Routing. Configuring Dynamic Routing protocols RIP, OSPF.	Windows/Linux OS, Packet Tracer	Static and Dynamic Routing over a network
4	Examining Network Address Translation (NAT). Configuring a Cisco Router as a DHCP Server	Windows/Linux OS, Packet Tracer	Configuration and working of NAT with setup of DHCP server.
Part C: Mini Project 2: Performance Analysis of TCP and UDP applications over the different Topologies of network			
1	Consider Six nodes and demonstrate the different ways of connecting them in topology methods. Also specify the different transmission media with specific channel specifications.	Python, NS3, Ubuntu.	Create an interface between the devices using different topologies.
2	Configure the IP address of the nodes in the specified network. Achieve the port specifications for different applications. Apply and Demonstrate the TFTP on the specified network using UDP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using UDP based applications
3	Apply and Demonstrate the FTP and TELNET on the specified network using TCP. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the performance using TCP based applications
4	Apply and Demonstrate the Congestion and Error Controlling mechanism in the specified networks. Observe the trace results.	Python, NS3, Ubuntu.	Analyze the congestion and error controlling in TCP based applications

TEXT BOOKS:

1. Behrouz A Forouzan, "Data Communications and Networking", 5th Edition, McGraw – Hill, 2016.
2. Nader F. Mir, "Computer and Communication Networks", Pearson Education, 2009.

REFERENCE BOOKS:

1. Alberto Leon-Garcia and Indraidjaja, "Communication Networks – Fundamental Concepts and Key Architectures", 2nd Edition Tata McGraw – Hill, 2004.
2. Andrew S. Tanenbaum, "Computer Networks", 4th Edition, Pearson Education, 2005.
3. Larry L. Peterson and Bruce S. Davie, "Computer Networks- A system Approach", 5th Edition, Elsevier, 2012.
4. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2008.
5. Douglas E. Comer, "Internetworking with TCP/IP", Vol.1, 6th Edition, Pearson, 1995.

JOURNALS/MAGAZINES:

1. IEEE Transactions on Networking.

2. Elsevier Journal of Computer Networks
3. Springer Journal of communications and Information networks.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/topic/computer-network/
2. https://www.coursera.org/courses?query=computer%20network
3. https://nptel.ac.in/courses/106/105/106105183/
4. https://www.edx.org/learn/computer-networking

SELF-LEARNINGEXERCISES:

Wifi, WiMAX, 4G, 5G, Satellite Networks, MPLS, VPN, ATM. Bluetooth Architecture. World Wide Web (WWW).

Course Title	**Smart Sensors and Transducers**				**Course Type**		**Theory**	
Course Code	**B20EK0501**	**Credits**	**4**		**Class**		**V semester**	
Course Structure	TLP	Credits	ContactHours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice				Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**5**	**39**		**50**	**50**

COURSE OVERVIEW

The course provides overview of various types of sensors and transducers, and also discuss their performance characteristics. The course also describes the different types of intelligent sensors which are self-adapting and self-validating. The concepts like linearization, calibration and compensation for sensors are also explained.

COURSE OBJECTIVE (S):

To make student understand the operation principles of different sensors for industrial and environmental use.

To equip the students to characterize the sensors in terms of metrological criteria and evaluate their performance.

To instill the ability among students to choose the appropriate sensor for measurement, process control and environmental monitoring applications and apply it in a correct way.

To provide the skills to implement simple data acquisition systems and to analyze and evaluate the acquired data.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the operation principles of different sensors for industrial and environmental use.	1,2,3, 4, 8, 9, 12	1

CO2	Characterize the sensors in terms of metrological criteria and evaluate their performance.	1,2,3, 5,9,12	1
CO3	Choose the appropriate sensor for measurement, process control and environmental monitoring applications and apply it in a correct way.	1,2,3,4,5, 9, 12	2
CO4	Implement simple data acquisition systems and to analyze and evaluate the acquired data.	1,4,5,9,12	1
CO5	Explain the working principle of various inductance and capacitance transducers	1,5,8,9,12	1
CO6	Discuss the operation and applications of modern industrial transducers.	4,9,12	1

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		√				
C06			√			

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2				1	1			1	3		
CO2	3	2	3		2				1			1	3		
CO3	3	1	2	1					1			1	3	3	
CO4	3			2	2				1			1	3		
C05	2				2			2	2			2	2		
C06				2					2			2	2		

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

COURSE CONTENT

THEORY:

UNIT-1
Classical Sensors and Transducers: Classification, Self-Generating Transducers, Variable Parameter Transducers: Resistance or Conductance Variation, Capacitance Variation Magnetic Properties Variation, Pulse or Frequency-Generating Type; Semiconductor Sensors: Semiconductor Thermal Sensors, Semiconductor Pressure Sensors, Semiconductor Magnetic Sensors, Hall-Effect Sensors, Photodiodes and Phototransistors; **Array-Based Sensors:**Preprocessing, Feature Extraction, Classification and Decision Making; Biosensors, Actuating Devices: Electrical Solenoid, Electrical Motors. **Sensor Performance Characteristics:** Introduction, Static Characteristics: Accuracy and Precision; Error, Correction and Uncertainty; Repeatability, Reproducibility and Hysteresis; Sensitivity, Offset, and Dead Band; Resolution and Linearity, Statistical Characteristics, Error Modeling; Dynamic Characteristics: Dynamic Error and Dynamic Sensitivity; Input–Output Impedances.
UNIT-2
Intelligent Sensors: Introduction: Classification; Smart Sensors: Monolithic Integrated Smart Sensor, Hybrid Integrated Smart Sensors; Soft or Virtual Sensors: Soft Sensor Secondary Variable Selection: Rough Set Theory; **Model Structures**: Artificial Neural Network Models; **Self-Adaptive Sensors**: Algorithmic Adaptation with Nonredundant Time of Measurement, Frequency to Digital Conversion Using Microcontroller; Self-Validating Sensors: **Functional Validation**: Numerical Method Artificial Intelligence for Sensor Validation, Neural Network–Based Approach; VLSI Sensors; Temperature Compensating **Intelligent Sensors**: Effects of Temperature on Sensors; Temperature Compensation Techniques: Circuit Compensation; Examples of Temperature Compensation in Sensor: Temperature Compensation of Thermal Flow Sensors, Temperature Compensation of Hot Film Crosswind Sensor, Integrated Hardware Compensation of Pressure Sensor, Integrated Compensation for Pressure Sensor; **Microcontroller-Based Compensation**: Frequency Control, Sensitivity Slope Control.
UNIT-3
Linearization, Calibration, and Compensation: Introduction; Analog Linearization of Positive Coefficient Resistive Sensors: Linearization by Shunt Resistance: Positive Feedback OPAMP Circuit (Current Source), Positive Feedback OPAMP Circuit(Voltage Source), Linearization Using Feedback Amplifier; Nonlinear ADC- and Amplifier-Based Linearization: Nonlinear Counting–Type ADC; Interpolation: Linear Interpolation; Piecewise Linearization: Analog Processing, Digital Processing: Lookup Table–Based ADC, Piecewise Linear ADC; Microcontroller-Based Linearization: Lookup Table Method; Artificial Neural Network–Based Linearization; Nonlinear Adaptive Filter–Based Linearization; **Sensor Calibration**: Conventional Calibration Circuits, Resistor Adjustment–Based Analog Calibration, Digitally Programmable Resistor; Multiplying DAC Calibration; Offset Calibration; Pulse-Modulated Calibration; ADC Calibration: Sigma–Delta ADC Calibration; **Offset Compensation**: Improved Manufacturing Process; Error and Drift Compensation: Drift Simulation; Lead Wire Compensation: Self-Heating Method.
UNIT-4

Sensors with Artificial Intelligence: Introduction: Artificial Intelligence: Reasoning, Knowledge, Planning, Learning; Sensors with Artificial Intelligence: Multidimensional Intelligent Sensors: Gas Classification and Recognition, Localization and Spatial Distribution; AI for Prognostic Instrumentation: Identification of Failure Predictors, Sensors for Measurement of Conditions, Data Storage, Processing, and Analysis, Fault and Degradation Models, Estimation of Failure and Degradation and Artificial Intelligence–Based Prognostics; ANN-Based Intelligent Sensors: Linearization and Calibration by ANN, Compensation of Error by ANN, Soft Sensing by ANN, Fault Detection by ANN; Fuzzy Logic–Based Intelligent sensors.

TEXTBOOKS:

1. ManabendraBhuyan. “Intelligent Instrumentation-Principles and Applications”, CRC Press,2011.

REFERENCEBOOKS:

Randy Frank,” Understanding Smart Sensors”, ARTECH HOUSE, 2013.

JOURNALS/MAGAZINES

1. Smart Sensors, Measurement and Instrumentation, Springer.

SWAYAM/NPTEL/MOOCs:

1. Coursera - Sensors and Sensing Techniques.
2. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

SELF-LEARNINGEXERCISES:

1. Signals and System Dynamics
2. Intelligent Sensor Standards and Protocols

Course Title	Machine Learning& Applications				Course Type		Theory	
Course Code	B20EK0502	Credits	4		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can process through large volumes of data at high speed to make predictions or decisions without human intervention.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain machine learning and problems relevant to machine learning.
2. Discuss the fundamentals of Decision trees learning and its issues
3. Illustrate neural networks, Bayes classifier and k nearest neighbour for problems appearing in machine learning.
4. Describe statistical analysis of machine learning techniques.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design the learning system to provide the solution for the given problem.	1,2,3,4,5	1, 2, 3
CO2	Apply Decision Tree technique for Classification problem	1,2,3,4,5	1, 2, 3
CO3	Develop Recognition or Prediction systems using Neural Network/Bayesian Model	1,2,3,4,5	1, 2, 3
CO4	Solve the problem by hypothesis testing using probability and statistics.	1,2,3,4,5	1, 2, 3
CO5	Understand ability of technological enhancement via improvising versions of machine learning knowledge transfer learning and deep learning	10,12	2,3
CO6	Analysing the influence of extended machine learning terminologies vis lifelong learning	11,12	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

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2									3	3	3
CO2	2	2	2	2									3	3	3
CO3	2	3	2	2									3	3	3
CO4	3	2	2	2									3	3	3
CO5										2		3		2	2
CO6											3	3		3	3

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

COURSE CONTENT:

THEORY

UNIT-1

Introduction: Well posed learning problems, designing a Learning system, Perspective and Issues in Machine Learning.

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate

Elimination algorithm, Inductive Bias
UNIT-2 **Decision Tree Learning:** Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
UNIT – 3 **ArtificialNeuralNetworks**: Introduction,NeuralNetworkrepresentation,appropriate problems, Perceptrons, Back propagation algorithm.
UNIT-4 **Evaluating Hypothesis**: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. Instance Based Learning: Introduction, k-nearest neighbour learning, locally weighted regression, radial basis function, cased-based reasoning. function,

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition McGraw Hill Education,2013.

REFERENCEBOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, 2nd edition, springer series in statistics.
2. EthemAlpaydın, “Introduction to machine learning”, second edition, MIT press.

JOURNALS/MAGAZINES:

1. https://www.sciencedirect.com/journal/machine-learning-with-applications
2. https://www.journals.elsevier.com/machine-learning-with-applications/https://ieeexplore.ieee.org/abstract/document/9409789/

SWAYAM/NPTEL/MOOCS:

1. Machine Learning for science and engineering applications
2. Applications of Machine Learning-Coursera

SELFLEARNING EXERCISES:

Reinforcement Learning: Introduction, Learning Task, Q Learning

COURSE OVERVIEW

This course introduces the basics of building IoT applications and second section follows a project-based approach. The Internet of Things (IOT) has managed to attract the attention of researchers and tech enthusiasts, since it powerfully combines classical networks with instruments and devices. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe about the Python languages and packages of Interest for IoT.

2. Elaborate the Physical IoT devices and its interfaces.
3. Describe the Java Programming for IoT applications
4. Illustrate the development environment of Blynk, configure the setup and describes the connection of sensor onMobile Device.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the components required for developing an IOT application.	1,3,4,7,10	2,3
CO2	Analyse the working of heterogenous sensors in the given real world applications.	1,2,4,4,7,10	2,3
CO3	Develop IoT application using Java or python programming.	1,2,3,4,7,10,11,12	2,3
CO4	Build a real world application using Blynk tool.	1,2,4,5,7,10,11,12	2,3
CO5	Learn new tools and technologies in the domain of IoT and cloud and apply for suitable application development.	12	2
CO6	Develop solutions in the field of IoT and cloud to the complex problems, either individually or a part of the team and report the results with proper analysis and interpretation. (map this with P	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level					
CO#	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**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2	3			2			2				3	3
CO2	3	3		3	2		2			1				3	3

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1 **IoT Logical Design using Python:** Introduction, Installing Python, Data types and Data structures ,Control flow, Functions, Modules, Packages, File Handling, Date/Time Operation, Classes, Python Packages of Interest for IoT.
UNIT-2 **IoT Physical Devices:** What ia an IoT Devices, Exemplary Device: Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry pi with Python, ,Other IoT Devices.
UNIT-3 **Java Programming for IoT Application :**IoT Communication Protocol, IoT Platform,IoT Security,Java IoT with Raspberry Pi,An Oracle Java ME Embedded Client,Other Java IoT Uses.
UNIT-4 **Introduction to Blynk and Connecting with sensors on Mobile device:** Setting up a development environment, what is Blynk, The Blynk appbuilder, Getting part, Setting up software on Raspberry pi, Installing prerequisite software on Raspbian, Connecting Raspberry Pi with Blynk cloud. Building your first Blynk Application.Using controller widgets: creating a project, slider ,step, ZeRGBa, Joystick.Using Display widgets: value display, LED, Using Notification Widgets: Twitter, email, Accelerometer, Light Sensor, Proximity Sensor.

TEXTBOOKS:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands on Approach”, Universities Press, First Edition, ISBN 978 81 7371 9547.
2. Perry Xiao,”Practical Java Programming For IoT,AI And Blockchain”,WILEY 2019 ISBN 978-1-119-56001-2.
3. Pradeeka Seneviratne ,“Hands on Internet of Things with Blynk”, packt publishinh Ltd, First edition ,ISBN 978-1-78899-506-1.

REFERENCEBOOKS:

1. David Hanes, Gonzalo Salgueiro ,Patrick Grossetete, Rob Barton ,Jerome Henry,”IoT Fundamentals Networking Technologies ,Protocols and Use Cases for the Internet of Things”,Ciscopress.com, Person India Education Services Pvt Ltd.ISBN 978 81 7371 9547.

2. Adrian McEwen ,Hakim Cassimally “Designing he Internet of Things”,WILEY Indian Pvt Ltd. ISBN:978-81-265-5686-1.

JOURNALS/MAGAZINES

1. https://link.springer.com/article/10.1007/s11227-018-2652-7
2. https://journalofcloudcomputing.springeropen.com/
3. https://ieeexplore.ieee.org/document/7600359
4. https://www.ijedr.org/papers/IJEDR1902052.pdf

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies -Coursera

SELF-LEARNINGEXERCISES:

Data Analytics for IoT, Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture,Productivity Applications Setting up a personal Blynk server, Controlling a Robot with Blynk.

The list of experiments are:

The Weka tool should be taught to the students

1. Introduction to WEKA, installation of WEKA Tool and demonstration.
2. Perform data preprocessing.
3. Perform classification to the dataset.
4. Perform Clustering using k-means for the contactlens dataset.
5. Perform Logic Regression for Iris data set.
6. To Visualize the results usingtheTool.
7. To Analyze the results using the Tool.
8. Apply ID3 decisiontree algorithm to House database.
9. Apply CART decisiontree algorithm To IRIS database

Course Title	Introduction to Robotics & Drones (PE-1)				Course Type		Theory	
Course Code	B20EKS501	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

This course introduces techniques, algorithms and principles of interactive computer graphicsand animation, this course also prepares for study in real-time rendering, realistic image synthesis, and computer animation.

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Outline the fundamentals and architecture of robotics.	1,2,3,4,5	1, 2
CO2	Design an Intelligent module to control robotic system.	1,2,3,4,5	1, 2
CO3	Develop robotic vision system using transformation techniques and sensors.	1,2,3,4,5,9	1, 2
CO4	Make use of innovative robotic devices for industrial and socially relevant applications.	1,2,3,4,5	1, 2
CO5	Learn new tools and technologies in the introduction to drones and robotics and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the introduction to drones and robotics to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/ 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	3	3	3								3	3	
CO3	3	3	3	3	3				1				3	3	
CO4	3	3	2	2	2								3	3	
CO5	3	3		2									3		3
CO6	3	3	2		2								3		3

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

COURSE CONTENT

THEORY

UNIT-1

Introduction: Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot- Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system.

UNIT-2

End effectors and robot controls: Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple

problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Illustration using ARDUINO Boards

UNIT-3

Robot transformations and sensors: Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, and Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors, Illustration using ARDUINO Boards

UNIT-4

Robot cell design and applications :Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using MATLAB, NXT Software Introductions-Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and undersea robot. Introduction to robotic operating system (ROS) .

TEXT BOOKS:

1. S.R. Deb, "Robotics Technology and flexible automation", Tata McGraw-Hill Education, 2009.

2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss,Roger N Nagel, Ashish Dutta, "Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

REFERENCE BOOKS:

1. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin,"Robotics Engineering an Integrated Approach", Phi Learning.,2009.

2. Francis N. Nagy, AndrasSiegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.

3. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing Company Ltd., 1995

4. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.

5. Craig. J. J., "Introduction to Robotics mechanics and control", Addison- Wesley, 1999.

6. Elsevier Journal of Robotics and autonomous systems.

7. IEEE Journal on robotics and automation.

JOURNALS/MAGAZINES

Drones in humanitarian contexts, robot ethics, and the human–robot interaction, Springer Journal

SWAYAM/NPTEL/MOOCS:

1. Robotics: Aerial Robotics – Coursera
2. https://onlinecourses.nptel.ac.in/noc20_de11/preview

SELF-LEARNING EXERCISES:

MICRO/NANO ROBOTICS SYSTEM, MATLAB, NXT Software, Bio inspired Robots, Home automation Robots.

SELF- LEARNINGEXERCISES:

1. Experiment with problems on Kaggle.com
2. Tweak the given solutions with changes to hyper-parameters

Course Title	Predictive Analytics Using Python (PE-I)				Course Type		Theory	
Course Code	B20EKS502	Credits	3		Class		Vsemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course focuses on Predictive Analytics using Python. This course introduces basics of Python and code some simple programs. The purpose is to predict the future by using the programming concepts of Python, to help in making good decisions. It presents the enormous opportunities and power associated with our ability to interrogate complex datasets, extract useful information, derive knowledge, and provide actionable forecasting. Biomedical, healthcare, and social datasets will provide context for addressing specific driving challenges. Students will learn about modern data analytic techniques and develop skills for importing and exporting, cleaning and fusing, modelling and visualizing, analyzing and synthesizing datasets. This course benefits is to understand the basics of data science and the implementation of the Predictive Analytics for future decisions.

COURSE OBJECTIVE (S):

The objectives of this course are to:

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

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamentals of Python Programming Language	1,2,3,4,5,6	1,2
CO2	Apply and compare basic machine learning techniques using Python for	1,2,3,4,5,6	1,2
CO3	Discover different data wrangling methods.	1,2,3,4,5,6	1,2
CO4	Justify the statistical concepts of predictive modeling.	1,2,3,4,5,6	2
CO5	Design and Develop algorithms to learn Regression techniques for data analysis	1,2,3,4,5,6	2
CO6	Propose different analytics and build models for real world data science problems	1,2,3,4,5,6	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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	2	2							3	3	
CO2	3	2	3	2	2	1							3	3	
CO3	3	2	2	2	1	1							2	2	
CO4	3	2	3	3	2	1								3	
CO5	3	2	3	3	2	1								3	
CO6	3	2	2	3	3	1								3	3

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

COURSE CONTENT

THEORY

Contents
UNIT 1
A brief introduction to Python : Introduction to Python: Installing Python: Python on Windows; Python on RedHat Linux; Python Installation from source; The Interactive Shell Your First Python Program: Diving in; Declaring Functions; Documenting Functions; Everything Is an Object; Indenting Code; Testing Modules Native Datatypes: Introducing Dictionaries; Introducing Lists; Introducing Tuples; Declaring variables; Formatting Strings; Mapping Lists; Joining Lists and Splitting Strings The Power of Introspection: Diving In; Using Optional and Named Arguments; Using type, str, dir, and Other Built−In Functions; Getting Object References With getattr; Filtering Lists; Using lambda Functions; Using Packages like numpy, scipy, scikit learn, matplotlib etc.,
UNIT 2
Getting Started with Predictive Modelling: Introducing predictive modelling, Applications and examples of predictive modelling, Installing and downloading Python and its packages, Working with different IDEs for Python. Data cleaning: Reading the data, various methods of importing data in python, basics- summary, dimensions, and structure, handlingmissing values, creating dummy variables, Visualizing a dataset by basic plotting.
UNIT 3
Data Wrangling, Subsetting a dataset, Selecting columns, Selecting rows, Selecting a combination of rows and columns, Creating new columns, Generating random numbers and their usage, Various methods for generating random numbers, Probability density function, Cumulative density function, Uniform distribution, Normal distribution, Using the Monte-Carlo simulation to find the value of pi, Geometry and mathematics behind the calculation of pi, Generating a dummy data frame, Grouping the data – aggregation, filtering, and transformation, Random sampling – splitting a dataset in training and testing datasets, Concatenating and appending data, Merging/joining datasets **Statistical Concepts for Predictive Modelling**: Random sampling and the central limit theorem, Hypothesis testing, Null versus alternate hypothesis, Z-statistic and t-statistic, Confidence intervals, significance levels, and p-values, Different kinds of hypothesis test, A step-by-step guide to do a hypothesis test, An example of a hypothesis test, Chi-square tests, Correlation.
UNIT 4
Linear Regression with Python: Understanding the maths behind linear regression, Linear regression using simulated data, Fitting a linear regression model and checking its efficacy, Finding the optimum value of variable coefficients, Making sense of result parameters, p-values, F-statistics, Residual Standard Error, Implementing linear regression with Python, Multiple linear regression, Multi-collinearity, Variance Inflation Factor, Model validation, Training and testing data split, Linear regression with scikit-learn, Feature selection with scikit-learn, Handling other issues in linear regression, Handling categorical variables, Transforming a variable to fit non-linear relations, Handling outliers, Other considerations and assumptions for linear regression **Logistic Regression with Python:** Linear regression versus logistic regression, Understanding the math behind

logistic regression Contingency tables, Conditional probability, Odds ratio, Moving on to logistic regression from linear regression, Estimation using the Maximum Likelihood Method, Building the logistic regression model from scratch, Making sense of logistic regression parameters, Implementing logistic regression with Python

TEXTBOOKS:

1. Ashish Kumar, "Learning Predictive Analytics with Python" :Packt Publishing, February 2016

2. Joseph Babcock, Ashish Kumar "Python: Advanced Predictive Analytics" Packt Publishing, December 2017.

3.JohnMaindonald, W. John Braun, "Data Analysis and Graphics Using R – an Example Based Approach", 3rd Edition, Cambridge University Press, 2010.

4. Mark Pilgrim, Dive into Python, Copyright (C) 2000 Free Software Foundation

REFERENCE BOOKS:

1. Kenneth A. Lambert, Fundamentals of Python: First Programs (introduction to Programming), 1stEdition, CENAGELearning.

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs45/preview

2.Data Analysis with Python-Coursera

3.Python data products for Predictive Analytics -Coursera

SELF-LEARNING EXERCISES:

Data Visualization: Plotting line graph, bar graph, Scatter Plot & box plot

Course Title	Cryptography & Network Security (PE-I)				Course Type		Theory	
Course Code	B20EKS503	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Computers around the world are systematically being victimized by rampant hacking. The goal of the ethical hacker is to help the organization take preemptive measures against malicious attacks by attacking the system himself; all the while staying within legal limits. As technology advances and organization depend on technology increasingly, information assets have evolved into critical components of survival. If hacking involves creativity and thinking 'out- of-the-box', then vulnerability testing and security audits will not ensure the security proofing of an organization. To ensure that organizations have adequately protected their information assets, they must adopt the approach of 'defense in depth'. In other words, they must penetrate their networks and assess the security posture for vulnerabilities and exposure. This course helps develops individuals in the specific network security discipline of Ethical Hacking from a vendor-neutral perspective.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamental concepts of cryptography.
2. Describe public key cryptography and message authentication.
3: Demonstrate the key distribution using Symmetric or Asymmetric encryption
4. Discuss security applications in the field of Information technology

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamental concepts of cryptography.	1,2,3,4,5	1
CO2	Develop a program for implementing public key cryptography and	1,2,3,4,5	2
CO3	Build key distribution system using Symmetric or Asymmetric encryption	1,2,3,4,5	2, 3
CO4	Design and develop security applications in the field of Information technology.	1,2,3,4,5	2, 3

CO5	Implement encryption algorithms for real-wordapplications.	3,4,5	2,3
CO6	Differentiate many cryptography algorithms based on the requirement.	3,4,5	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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	1								3		
CO2	3	2	3	1	2									3	
CO3	3	1	2	2	3									3	3
CO4	2	2	2	1	1									3	3
CO5	2	2	2	1	1									3	3
CO6	2	2	2	1	1									3	3

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

COURSE CONTENT

THEORY

UNIT-1
Introduction: The OSI Security Architecture, Security Attacks, Security Services, mechanisms, Amodel for network security, symmetric encryption principles, Symmetric Block Encryption Algorithms, Data Encryption Standards, Strength of DES, Triple DES, Advanced Encryption Standard.
UNIT-2
Public-Key Cryptography and Message Authentication: Public key Cryptographic Principles,PublicKeyCryptographicAlgorithms(RSA, Diffie-Hellman), Approaches toMessageAuthentication, SecureHashFunctions(SHA-512), MessageAuthentication Codes, Digital Signatures. Introduction to Secure programming with the OpenSSL API: OpenSSL, Headers and initialization, Setting up an unsecured connection, Setting up a secure connection, Error detection.
UNIT-3
Network Security Applications: Symmetric key distribution using Symmetric encryption, Kerberos(Key Exchange), key distribution using Asymmetric encryption X.509 Certificate Format, Secure socket layer and transport layer security, PGP- Features of PGP, Key Rings in PGP, S/MIME, IP security Overview.
UNIT-4
System Security: Intrusion Detection, Password Management, Virus and threats, VirusCountermeasures, Firewalls, The Need for Firewalls, Firewall Characteristics, Types of Firewalls.Open Source Cryptography libraries -a C++98 crypto library, Mhash open source C library and Crypto ++.

TEXT BOOKS:

1.William Stallings, “Network Security Essentials Applications and Standards”, Fourth edition, Prentice Hall, 2011.

2.Behrouz A. Forouzan, “Cryptography and Network Security”, McGraw Hill, 2007.

REFERENCE BOOKS:

1.William Stallings, “Cryptography and Network Security Principles and Practice”, Pearson, Sixth edition, 2013

2. Joseph MiggaKizza,” Guide to Computer Security, Springer Science & Media In”c., Third edition, 2015

3.AndrewS.Tanenbaum, “Computer Networks”, Pearson, Fifth edition, 2015.

4.AtulKahate, “Cryptography and Network Security”, McGraw Hill, 2013.

JOURNALS/MAGAZINES:

1.Springer Journal of Cryptographic Engineering, ISSN 2190-8508

2.ACM,ACM- International Journal of Applied Cryptography, ISSN:1753-0563

3.IEEE, IEEE Transactions on Information Forensics and Security.

4.Elsevier, Journal of Information Security and Applications.

5. https://www.alienvault.com/blogs/security-essentials/open-source-network-security-tools-for-newbies.

SWAYAM/NPTEL/MOOCS:

1. Cryptography ad Network Security-Coursera

2. https://nptel.ac.in/courses/106/105/106105162/

SELF- LEARNING COMPONENT:

1. IOT complexity read to security issues and further DDOS attacks ,malware

2. Cloud security roles of AI and machine learning in cyber security

Course Title	Fuzzy Logic &Systems (PE-II)				Course Type		Theory	
Course Code	B20EAS504	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

Course Description: This course covers the introduction to Classical Sets, Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of Membership Functions, Fuzzification and Defuzzification, Development of Membership Functions, Decision Making with Fuzzy Information, Classification by Equivalence Relations, Fuzzy Pattern Recognition and to understand the difference between Logic and Fuzzy systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Provide insights about the basics of Classical Sets, Fuzzy Sets, Classical Relations and Fuzzy Relations.
2. Explain the Properties of Membership Functions, Fuzzification and Defuzzification and to identify the difference between Logic and Fuzzy systems.
3. Describe the Development of Membership Functions and to work with Decision Making using Fuzzy Information.
4. Classify Fuzzy System to know the interpretation of Fuzzy Pattern Recognition.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the fundamental concepts of Fuzzy sets, functions and classification to solve real world problems.	1,2,3,4,5	1, 2
CO2	Apply the different types of Fuzzy system and decision making with fuzzy.	1,2,3,4,5	1, 2
CO3	Develop Fuzzy logic to solve real life problems.	1,2,3,4	1, 2
CO4	Model the Fuzzy logic for the given problem domain.	1,2,3,4,5	1, 2
CO5	Learn new tools and technologies in the fuzzy logic and systems and apply for suitable application development.	12	1, 2
CO6	Develop solutions in to fuzzy logic and systems to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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

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

COURSE CONTENT

THEORY

UNIT-1
Introduction: Classical Sets and Fuzzy Sets: The Case for Imprecision, A Historical Perspective, The Utility of Fuzzy Systems, Limitations of Fuzzy Systems, The Illusion: Uncertainty and Accuracy, Uncertainty and Information, Fuzzy Sets and Membership, Chance versus Fuzziness, Sets as Points in Hypercube.
UNIT-2

Properties of Membership Functions, Fuzzification and Defuzzification: Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, Lambda -Cuts for Fuzzy Sets, Lambda - Cuts for Fuzzy Relations, Defuzzification to Scalars. **Logic and Fuzzy systems:** Part1 Logic, Part II Fuzzy Systems.
UNIT-3.
Development of Membership Functions - Membership Value Assignments. **Decision Making with Fuzzy Information:** Fuzzy Synthetic Evaluation, Fuzzy Ordering, Non - Transitive Ranking, Preference and Consensus, Multi Objective Decision Making, Fuzzy Bayesian Decision Method, Decision Making under Fuzzy States and Fuzzy Actions.
UNIT-4
Fuzzy Classification: Classification by Equivalence Relations - Crisp Relations, Fuzzy Relations, Cluster Analysis, Cluster Validity, c- Means Clustering - Hard c-Means (HCM), Fuzzy c-Means (FCM), Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering. Fuzzy Pattern Recognition: Feature Analysis, Partitions of the Feature Space, Single-Sample Identification, Multifeature Pattern Recognition, Image processing

TEXT BOOKS:

1. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India, 3rd Edition, 2010.

2. George K Klirand and Bo Yuan, “Fuzzy Sets and Fuzzy Logic: Theory and Applications”, Prentice Hall, 1995.

REFERENCE BOOKS:

1. B Kosko, “Neural Networks and Fuzzy Systems: A Dynamical System Approach”, PHI, 1991.

JOURNALS/MAGAZINES:

1. https://wireilla.com/ijfls/
2. https://publons.com/journal/88623/international-journal-of-fuzzy-logic-systems-ijfls/
3. Springer,Fuzzy Logic in Intelligent System Design
4. Springer, Recent Advances in Intuitionistic Fuzzy Logic Systems

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_ee03/preview
2. Fuzzy Logical Model of Perception-Coursera

SELFLEARNING EXERCISES:

1. Automated Methods for Fuzzy System, Batch Least Squares Algorithm, Recursive Least Squares
2. Algorithm, Gradient, Fuzzy Systems Simulation, Nonlinear Simulation Using Fuzzy System

CourseTitle	STORAGE AREA NETWORK (PE-I)				CourseType		Theory	
CourseCode	B20EKS505	Credits	3		Class		semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

This course provides an overview of storage network and data center networking technology. It reviews SAN concepts, Fibre Channel architecture, SAN topologies, SAN over Ethernet architectures, such as iSCSI, FCoE.Virtualization at the host, storage target and Fabric-Based Virtualization

COURSE OBJECTIVE(S)

The objective of this course is:

1. To introduce the mathematical basics of speech modeling, and its applications.
2. To understand the various applications of speech modeling
3. To comprehend the computational concepts learned in the lecture classes through numerical simulations and programming
4. To help the students extend their understanding of signal processing algorithms for speech processing.
5. To strengthen the research skills of students in speech processing.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify key challenges in managing information and analyze different storage networking technologies	1,2	1, 2
CO2	Understand components and the implementation of different storage networking technologies	1, 2,	2, 3
CO3	Analyze storage area network architecture and types of archives and forms of virtualization	1, 2, 4	2, 3
CO4	Illustrate the storage virtualization concepts at different levels	1, 2, 3	3
CO5	Develop an insight into the working of the storage network algorithms used for storage virtualization	1, 2, 3, 12	3
CO6	Develop solutions to the complex problems of storage virtualization, either individually or as a part of the team and report the results with proper analysis and interpretation.	5, 9, 10	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

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2											2	2	
CO2	2	2												2	2
CO3	2	3		3										2	2
CO4	3	2	3												3
CO5	3	2	3									3			3
CO6					3				3	3					3

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

COURSE CONTENT

THEORY

Contents
UNIT 1
Introduction to Information Storage and Intelligent Storage Systems: Evolution of Storage Architecture Data Center Infrastructure Virtualization and Cloud Computing Components of an Intelligent Storage System, Storage Provisioning, Types of Intelligent Storage Systems
UNIT 2
Fibre Channel Storage Area Networks and IP SAN: Fibre Channel, The SAN and Its Evolution, Components of FC SAN, FC Connectivity , Switched Fabric Ports, Fibre Channel Architecture , Zoning FC SAN Topologies , Virtualization in SAN iSCSI
UNIT 3
FCoE : FCIP, FCoE , General-Purpose Servers versus NAS Devices , Benefits of NAS , File Systems and Network File Sharing , Components of NAS , NAS I/O Operation , NAS Implementations, NAS File-Sharing Protocols , Factors Affecting NAS Performance
UNIT 4
Virtualization at the Host: Logical Volume Management, Storage Metadata Servers , Server-Based Storage APIs, **Virtualization at the Storage Target:** Array-Based Virtualization, Array-Based Data Replication, Array-Based Point-in-

Time Copy (Snapshot), Distributed Modular Array Virtualization, **Fabric-Based Virtualization:** Sentient SANs, Techniques for Switch-Based Virtualization, The Fabric Application Interface Standard (FAIS)

TEXTBOOKS:

1. Information Storage and Management,Author :EMC Education Services, Publisher: Wiley ISBN: 9781118094839
2. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company ISBN : 9780321262516

REFERENCE BOOKS:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2003.
2. Rebert Spalding: Storage Networks, The Complete Reference, Tata McGraw Hill, 2003

JOURNALS/MAGAZINES

1. Journal of Network and Systems Management-Springer
2. Future Generation Computer System- Science Direct.

SWAYAM/NPTEL/MOOCs

1. http://www.virtualnuggets.com/emcs--storage-area-network.html
2. https://www.udemy.com/course/storageintro/
3. https://www.ibm.com/training/course/SN71G

SELF-LEARNING EXERCISES:

Case study, Assignments, MOOC / Coursera/Conference

Course Title	**Digital System Design with Verilog (PE-I)**	**Course Type**	**Theory**

Course Code	B20EKS506	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course aims to provide students with the understanding of the different technologies related to HDLs, construct, compile and execute Verilog HDL programs using provided software tools. Design digital components and circuits that are testable, reusable, and synthesizable.

COURSE OBJECTIVE (S):

The objectives of this course is to:

1: Illustrate Verilog hardware description languages (HDL).

2: Discuss digital circuits required for various applications.

3: Explain the verification of Behavioral and RTL models.

4: Describe Synthesizing RTL models to standard cell libraries and FPGAs

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of Verilog hardware description languages (HDL) for Gate Level Modeling	1,2,3,4,5	1
CO2	Design digital circuits using Verilog for real world applications.	1,2,3,4,5	2
CO3	Make use of constructs of Verilog to design Shift registers and counters.	1,2,3,4,5	2
CO4	Develop Verilog code using Moore and mealy models for realizing Serial Adder.	1,2,3,4,5	2,3
CO5	Design digital systems that are reconfigurable for testing and test it on FPGA	1,2,5	1
CO6	Understandability in continuous learning with evolving technological development.	10,12	2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level

CO#	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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2								3		
CO2	3	3	2	3	2									3	
CO3	3	3	2	3	2								3		
CO4	3	3	3	3	3									3	3
CO5	3	3			3								3		
CO6										3		3		3	3

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

COURSE CONTENT

THEORY

UNIT-1
ASIC Design Flow, Introduction to Verilog, Language Constructs and Conventions in Verilog, Gate Level Modeling, Architecture of FPGA.
UNIT-2
Modeling at Data Flow Level, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Verilog for combinational Circuits, Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter
UNIT-3
Behavioral Modeling: Operator and Assignments, Functional Bifurcation, Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if-else, assign-deassign, repeat Construct, Loop Construct: for, while& forever, Parallel blocks, force- release construct, event Design of Flip flop, Shift register and Counters using Verilog.
UNIT-4

Functions, Tasks, user defined primitives, State Machine: Moore and mealy state model, Verilog code for Moore-type FSM, Specification of Mealy FSM using Verilog, Mealy-type and Moore-type FSM for Serial Adder.

TEXTBOOKS:

1. Brown & Z. Vransesic, "Fundamental of digital Logic with Verilog design", TMH, 2002

2.T.R. Padmanabhan& B. Bala Tripura Sundari, "Design through Verilog HDL", Wiley Publications, 2009.

REFERENCE BOOKS:

1. "Digital Design", F.rankVahid, Wiley, 2006.

2."Introduction to Digital Systems", , M. Ercegovac, T. Lang and L.J. Moreno, Wiley, 2000.

JOURNALS/MAGAZINES:

1. https://www.elsevier.com/books/digital-integrated-circuit-design-using-verilog-and-systemverilog/mehler/978-0-12-408059-1
2. https://www.elsevier.es/en-revista-journal-applied-research-technology-jart-81-articulo-a-new-design-methodology-for-S1665642313715293

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_ee39/preview
2. https://onlinecourses.nptel.ac.in/noc19_cs72/preview
3. FPGA Design for Embedded systems- Coursera

SELF-LEARNING EXERCISES:

Mealy-type and Moore type FSM for Serial Adder.

Course Title	**Introduction to AI (OE-1)**			**Course Type**	**Theory**
Course Code	**B2CI0501**	**Credits**	**3**	**Class**	**V semester**

Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basics of Artificial Intelligence (AI), AI problems and search strategies. The students can explore knowledge representation issues and methods. This course provides planning methods /algorithms for, problem solving and controlling the knowledge and also demonstrates various learning methods for constructing knowledge and taking decisions

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basics of Artificial Intelligence (AI).
2. Illustrate knowledge representation issues and methods
3. Explain planning methods/algorithms in problem solving
4. Discuss the application of AI in Robot .

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Solve AI problems using AI search strategies and production system	1,2,3,4,5	1,2
CO2	Develop knowledge base for representing the given real world data using logic and reasoning methods	1,2,3,4,5	1,2
CO3	Make use of planning and probability to solve uncertainty problems.	1,2,3,4,5	1,2
CO4	Design and develop an intelligent agent for robotics in a specific environmentto solve real world problems.	1,2,3,4,5	1,2,3
CO5	Learn new tools and technologies in the introduction to AI and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the introduction to AI to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level

CO#	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	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3								3	3	
CO2	3	3	3	2	3								3	3	
CO3	3	2	3	3	3								3	3	1
CO4	3	2	2	2	2								3	3	3
CO5	3	2	2	2									3	3	
CO6	3		2	2									3		3

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

COURSE CONTENT

THEORY

UNIT-1
Problems and search: What is AI, AI Problems; AI Techniques; Problem Space and Problem Search techniques; Defining the problem as a state space search, production systems; Problem characteristics, production system characteristics, Issues in the design of search programs; Heuristic search techniques, generate-and-test; Hill climbing, BFS, DFS; Problem reduction; Constraint satisfaction.
UNIT-2
Knowledge Representation: Knowledge representation Issues, representations and mappings; Approaches to knowledge representation; Issues in knowledge representation; Using Predicate logic: Representing simple facts in logic; Representing Instance and ISA relationships; Computable functions and predicates; Representing Knowledge using Rules; Procedural versus declarative knowledge; Resolution Forward versus backward reasoning; Matching
UNIT-3

Planning: A simple planning agent; Representations for planning; A partial-order planning example; A partial-order planning algorithm; Planning with partially Instantiated operators; Knowledge Engineering for planning; Uncertainty: Sources of Uncertainty; Probability Theory, Issues with Probability; Advantages & Disadvantages of Bayesian Network
UNIT-4
Robotic Sensing and Manipulation: Introduction to robotics, Sensing, Manipulation, Human-robot interaction **Mobile Robots:** Navigation and path planning, Learning and robotics: Reinforcement learning, Case study: Autonomous vehicles technologies and impacts

TEXTBOOKS:

1. Russell &Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice-Hall, 2010.
2. Elaine Rich, Kevin Knight, "Artificial Intelligence", ", 3rdedition, TataMcgraw Hill, 2009

REFERENCE BOOKS:

1. Nils J.Nilsson, Elsevier, "Principles of Artificial Intelligence", 1980. "Artificial Neural Networks",
2. Krishan Mehrotra, Chilkuri K. Mohan, Sanjay Ranka, "Artificial Neural Networks", Penram International Publishing, 1997.
3. B.Yegananarayana, "Artificial Neural Networks", PHI, 2001.

JOURNALS/MAGAZINES:

1. Springer- Springer transaction for security based intelligent systems
2. IEEE transaction for computational Intelligence
3. ACM, ACM transaction on Multi-Agent System.
4. Boston Dynamics videos, 2018 , https://www.youtube.com/user/BostonDynamics
5. Priday, R. "What's Really Going on in those Boston Dynamics Videos," Wired, February 18, 2018https://www.wired.co.uk/article/bostondynamics-robotics-roboticist-how-to-watch ○ RAND Institute, "Autonomous
6. RAND Institute, "Autonomous Vehicle Technology: A Guide for Policymakers", 2016

   https://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443- 2/RAND_RR443-2.pdf

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. Introduction to Artificial Intelligence -Coursera

SELF-LEARNING EXERCISES:

Natural Language Processing, Deep Learning

Course Title	**OOPS with C++ (OE-1)**			**Course Type**	**Theory**
Course Code	**B20CIO502**	**Credits**	**3**	**Class**	**Vsemester**

Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basic concepts of object-oriented programming. Familiarizes with object creation and accessing members of object. OOPs concepts such as data abstraction, information hiding (Encapsulation), overloading operations, inheritance mechanisms, virtual functions, friend functions and are discussed. FileI/O operations, Templates and exception handling mechanisms are also introduced

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of objects and classes for a real world application.
2. Illustrate the use of operator overloading/function overloading for given applications.
3. Demonstrate the use of inheritance in real world applications.
4. Describe I/O streams and Templates and Exception Handling

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the basic concepts of objects and classes for a real world application	2,3,7,11	1,2
CO2	Develop applications by implementing operator overloading and function overloading.	2,3,4,5	2,3
CO3	Make use Inheritance feature of OOPs to develop a real world application	1,2,3,4,8,9,11	2,3
CO4	Build the real world application using exception handling and templates	1-,2,3,4,11,12	2,3
CO5	Learn new tools and technologies in the OOPS with C++ and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the OOPS with C ++to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE OUTCOMES

	Bloom's Level

CO#	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**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5	1	3	3	2										2	1
CO6	1		3	2										2	1

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

COURSE CONTENT

THEORY

UNIT-1

Introduction: Introduction to object oriented concepts: Encapsulation, Abstraction, Inheritance,Polymorphism, Overview of OOP, Introduction to object oriented modelling, Introduction to variables in C++, I/O operators, Function overloading, Inline function, Recursive function.

Classes & Objects: Introduction to Classes, Member Functions and Member data, Constructors and Destructors, Static Class members.

UNIT-2

Operator overloading: Introduction to Objects, Array of Objects, Dynamic Objects, Pointers toobjects, Friend Function, Access specifiers.

The scope resolution operator, Generic functions and classes, Operator overloading using Friend function: Unary operator '+' & binary operator, Copy constructor.

UNIT-3

Inheritance: Base Class, Inheritance and Protected members, inheriting multiple baseclasses, Constructors, Destructors and Inheritance, Virtual base classes. Virtual functions and Polymorphism: Virtual functions, pure virtual functions, Early and latebinding.

UNIT-4

Templates and Exception handling: Template Functions, Template Classes, Fundamentals ofException handling, handling derived class exceptions.

TEXTBOOKS:

1. HerbertSchildt,"The Complete Reference C++", 4th Edition, Tata McGraw Hill, 2003.
2. SanleyB.Lippmann, JoseeLajore,"C++ Primer", 4th Edition, Pearson Education, 2005.

REFERENCE BOOKS:

1. Paul J Deitel, Harvey M Deitel,"C++ for Programmers", Pearson Education, 2009.
2. K R Venugopal, RajkumarBuyya, T Ravi Shankar,"Mastering C++", Tata McGraw Hill,l999.

JOURNALS/MAGAZINES:

1. https://www.scimagojr.com/journalsearch.php?q=24306&tip=sid
2. https://www.wiley.com/en-in/Object+Oriented+Programming+in+C%2B%2B+-p-9780470843994
3. https://ieeexplore.ieee.org/document/486097
4. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-73862001000300002

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/105/106105151/
2. Object oriented data structures in C++ -Coursera
3. C++ Classes and Object orientation-Coursera

SELF LEARNING EXERCISES:

I/O System Basics, File I/O: C++ stream classes, Formatted I/O, <fstream> and File classes.

COURSE OVERVIEW

Course Title	Web Technology (OE-1)				Course Type		Theory	
Course Code	B20CIO503	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

This course covers features of HTML 5 and CSS 3, controls and web services of ASP.Net and database access with MYSQL, basics of AngularJS, basics of AJAX and JQuery AJAX library, basics of Ruby, controls and RESTFul web services. These concepts are used in the development of Client-Server technology

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand the various steps in designing a creative and dynamicwebsite.
2. Describe the hierarchy of objects in HTML andXML.
3. Design dynamic and interactive web pages by embedding Java Script code inHTML.
4. Illustrate the advantages and use of different typesofCSS.
5. Examine the HTML. Know how to use DynamicHTML.
6. Familiarize server side scripting language like Perl&PHP.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the concepts of WWW including browser and HTTPprotocol and summarize the various HTML tags and use them to develop the user	2,3,7,11	1,2
CO2	Define the CSS with its types and use them to provide the styles to the web pages at variouslevels.	2,3,4,5	2,3
CO3	Develop the modern web pages using the HTML and CSS features with different layouts as per need ofapplications.	1,4,8,9,11	2,3
CO4	Apply JavaScript to develop the dynamic webpages and use server side scripting with PHP to generate the web pages dynamically using the	1,2,3,4,11,12	2,3
CO5	Learn new tools and technologies in the web technology and apply for suitable application development.	12	1, 2

CO6	Develop solutions in the web technology to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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 ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1				1				1		2	2	
CO2		2	3	1	1									3	1
CO3	1	2	1	2				3	1		1			2	1
CO4	1	2	3	1							1	1		2	1
CO5	1		3											2	1
CO6		2	3												

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

COURSE CONTENT

THEORY

UNIT-1

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers-Case Study. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics- Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-XML Creating HTML Documents. Representing Web Data: XML-

Documents and Vocabularies-Versions and Declaration - Namespaces JavaScript andXML
UNIT-2 **Style Sheets:** Lists, Tables, Forms, Frames CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution. Javascript: Overview of Javascript, Object orientation and Javascript, Syntactic characteristics, Primitives, operations, and expressions, Screen output and keyboard input, Control statements, Object creation and modification, Arrays, Functions, Constructors.
UNIT-3 **Perl, CGI Programming:** Origins and uses of Perl, Scalars and their operations, Assignment statements and simple input and output, Control statements, Fundamentals of arrays, Hashes, References, Functions, Pattern matching, File input and output; Examples. The Common Gateway Interface; CGI linkage; Query string format; CGI.pm module; Cookies. Database access with Perl and MySQL
UNIT-4 **Introduction and basic syntax of PHP:** decision and looping with examples, PHP and HTML, Arrays, functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP. **PHP and MySQL:** Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables

TEXTBOOKS:

1. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, PearsonEducation.

2. JeffreyC.Jackson,"WebTechnologies--AComputerSciencePerspective",PearsonEducation,2006. 2007.

REFERENCE BOOKS:

1. Harvey M. Deitel, Paul J. Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education,2006.
2. Marty Hall and Larry Brown, “Core Web Programming” Second Edition, Volume I and IIPearson Education,2001.
3. Bates, “Developing Web Applications”, Wiley, 2006.

JOURNALS/MAGAZINES:

1. International Journal of Web Technology-ISSN:2278-2389
2. International Journal of Web &SemanticTechnology(IJWesT)
3. ELSEVIERJournalswithin"InternetAndWebTechnology”

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/105/106105084/
2. Introduction to Web development-Coursera

SELF-LEARNING EXERCISES:

Rails, Angular JS complete study.

Course Title	Technical Documentation				Course Type		Theory	
Course Code	B20CI0503	Credits	1		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**1**	**1**	**1**	**13**	**0**	**50**	**50**

COURSE OVERVIEW

The goal of this course is to prepare engineering students with the individual and collaborative technical writing, presentation, and research skills necessary to be effective technical communicators in academic and professional environments

COURSE OBJECTIVE (S):

The objectives of this course are:

1. Understanding the characteristics of technical writing and the importance of purpose, audience, and genre for written communication in technical fields.
2. Planning, drafting, revising, editing, and critiquing technical and professional documents through individual and collaborative writing.
3. Writing effective technical documents that are grammatically and stylistically correct.
4. Explain the knowledge and skills required for undertaking a research project, for presenting a conference paper and for writing a scientific article.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Describe the characteristics of technical writing and the importance of purpose, audience, and genre for written	1,2,3 4, 8, 9 , 12	1
CO2	Develop professional documents through individual and collaborative writing.	1,2,3, 5,9,12	1
CO3	Write effective technical documents that are grammatically and stylistically correct	1,2,3,4 5, 9, 12	2
CO4	Writing effective paper for conference or journal publication	1,4,5,9,12	1
CO5	Learn new tools and technologies in the technical documentationand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the technical documentation to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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			√			
CCO6			√			

COURSE ARTICULATION MATRIX

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

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

COURSE CONTENT

THEORY

UNIT-1
Introduction Technical Reports: Importance of Reports, Objectives of Reports , characteristics of a Report , Categories of Reports, Informative Reports , Analytical Reports , Periodic and Special Reports , Oral and Written Reports , Long and
UNIT-2
Short Reports , Formal and Informal Reports , Individual and Group Reports , Formats , Prewriting , Purpose and Scope , Audience , Sources of Information , Organizing the Material , Interpreting Information , Making an Outline , Structure

UNIT-3
, Audience , Sources of Information , Organizing the Material , Interpreting Information , Making an Outline , Structure of Reports (Manuscript Format), Prefatory Parts , Main Text , Supplementary Parts , Types of Reports , Writing the Report , First Draft , Revising, Editing, and Proofreading
UNIT-4
Technical Proposals: Introduction, Definition and Purpose, Types, Characteristics , Structure of Proposals , Prefatory Parts , Body of the Proposal , Supplementary Parts , Style and Appearance , Evaluation of Proposals. **Research Papers and Technical Descriptions**: Introduction, Research Paper , Characteristics , Components , Technical Description , Guidelines for Writing Good Descriptions , Checklist .

TEXTBOOKS:

1. Meenaxi Raman and Sangeetha Sharma, “Technical communication”, Oxford University press, 2015.
2. C. R. Kothari, Research Methodology Methods and Techniques, 2nd. ed. New Delhi: New Age International Publishers, 2009.
3. R. Panneerselvam, Research Methodology, New Delhi: PHI, 2005.
4. P. Oliver, Writing Your Thesis,NewDelhi:Vistaar Publications, 2004.
5. F. Mittelbach and M. Goossens,The LATEX Companion, 2nd. ed. Addison Wesley, 2004.

Course Title	AI& Humanity				Course Type		Theory	
Course Code	B20EA0501	Credits	2		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of Classes Per Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**2**	**2**	**2**	**26**	**0**	**50**	**50**

COURSE OVERVIEW

AI and Humanity provides an analytical framing and a common language for understanding the effects of technological advances in artificial intelligence on society. The theme is driven by an exploration of the cultural and etymological roots of a series of keywords relevant to both AI and society. Here the possibility of applying the key principles and tools of current artificial intelligence (AI) to design future human systems in ways that could make them more efficient, fair, responsive, and inclusive.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of artificial intelligence and its applications to society.
2. Discuss the machine learning concepts.
3. Inculcate knowledge of data processing and building classifiers in various application domains.
4. Gain expertise in logic programming and search techniques.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of AI Techniques to solve social problems.	1 to 4, 8, 9 , 12	1
CO2	Develop programs for machine learning algorithms.	1 to 3, 5,9,12	1
CO3	Apply the techniques of data preprocessing and build a classifier.	1 to 5, 9, 12	2
CO4	Create search solutions for different application.	1,4,5,9,12	1
CO5	Learn new tools and technologies in the AI and humanity and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the AI and humanityto the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation	5,9,10	1,2

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

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

COURSE CONTENT

THEORY:

UNIT-1
Introduction: Basic Concept of Artificial Intelligence (AI), The Necessity of Learning AI, What is Intelligence?, What is Intelligence Composed Of?, What's Involved in AI, Application of AI,
UNIT-2
AI and Machine Learning: Types of Machine Learning (ML), supervised machine learning algorithms, unsupervised machine learning algorithms, Reinforcement machine learning algorithms,
UNIT-3
Data Preparation and Building a Classifier: Techniques for Data Preprocessing**AI and Machine Learning**: Types of Machine Learning (ML), supervised machine learning algorithms, unsupervised machine learning algorithms, Reinforcement machine learning algorithms, , Labeling the Data, , Naïve Bayes Classifier, Support Vector Machines (SVM), Logistic Regression, Decision Tree Classifier, Random Forest Classifier, Performance of a classifier, Class Imbalance Problem, Sampling.
UNIT – 4

Logic Programming and Gaming: How to Solve Problems with Logic Programming,Heuristic Search, Difference between Uninformed and Informed Search, Minimax Algorithm, Alpha-Beta Pruning.

TEXTBOOKS:

1. Illah Reza Nourbakhsh , AI and Humanity, , publishers Pearson, March 2020.
2. Coleman, Flynn ,How Artificial Intelligence is redefining who we are.. A Human Algorithm: Counterpoint Press, 2019.

REFERENCEBOOKS:

1. Prateek Joshi, Artificial Intelligence with Python first edition , Packt publishers.,2017
2. Stuart Jonathan Russell, Peter Norvig ,Artificial Intelligence For Dummies

JOURNALS/MAGAZINES:

1. https://www.jair.org/index.php/jair

2. https://ijai.iaescore.com/index.php/IJAI

3. http://www.ceser.in/ceserp/index.php/ijai

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview

2. AI for everyone -Coursera

SELF-LEARNING EXERCISES:

AI and Neural Networks, Deep Learning

Detailed Syllbus

Semester 6

Course Title	IOT and Cloud Programming				Course Type		Integrated	
Course Code	B20EK0602	Credits	3		Class		VIISemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basics of building IoT applications and second section follows a project-based approach. The Internet of Things (IOT) has managed to attract the attention of researchers and tech enthusiasts, since it powerfully combines classical networks with instruments and devices. Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, vizualize it and do many other cool things.

COURSE OBJECTIVE (S):

The objectives of this course are to:

5. Describe about the Python languages and packages of Interest for IoT.
6. Elaborate the Physical IoT devices and its interfaces.
7. Describe the Java Programming for IoT applications
8. Illustrate the development environment of Blynk, configure the setup and describes the connection of sensor onMobile Device.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the components required for developing an IOT application.	1,3,4,7,10	2,3
CO2	Analyse the working of heterogenous sensors in the given real world applications.	1,2,4,4,7,10	2,3
CO3	Develop IoT application using Java or python programming.	1,2,3,4,7,10,11,12	2,3
CO4	Build a real world application using Blynk tool.	1,2,4,5,7,10,11,12	2,3

CO5	Learn new tools and technologies in the domain of IoT and cloud and apply for suitable application development.	12	2
CO6	Develop solutions in the field of IoT and cloud to the complex problems, either individually or a part of the team and report the results with proper analysis and interpretation. (map this with P	5,9,10	2

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
IoT Logical Design using Python: Introduction, Installing Python, Data types and Data structures ,Control flow, Functions, Modules, Packages, File Handling, Date/Time Operation, Classes, Python Packages of Interest for IoT.
UNIT-2
IoT Physical Devices: What ia an IoT Devices, Exemplary Device: Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry pi with Python, ,Other IoT Devices.

UNIT-3
Java Programming for IoT Application : IoT Communication Protocol, IoT Platform,IoT Security,Java IoT with Raspberry Pi,An Oracle Java ME Embedded Client,Other Java IoT Uses.
UNIT-4
Introduction to Blynk and Connecting with sensors on Mobile device: Setting up a development environment, what is Blynk, The Blynk appbuilder, Getting part, Setting up software on Raspberry pi, Installing prerequisite software on Raspbian, Connecting Raspberry Pi with Blynk cloud. Building your first Blynk Application.Using controller widgets: creating a project, slider ,step, ZeRGBa, Joystick.Using Display widgets: value display, LED, Using Notification Widgets: Twitter, email, Accelerometer, Light Sensor, Proximity Sensor.

TEXTBOOKS:

4. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands on Approach”, Universities Press, First Edition, ISBN 978 81 7371 9547.
5. Perry Xiao,”Practical Java Programming For IoT,AI And Blockchain”,WILEY 2019 ISBN 978-1-119-56001-2.
6. Pradeeka Seneviratne ,“Hands on Internet of Things with Blynk”, packt publishinh Ltd, First edition ,ISBN 978-1-78899-506-1.

REFERENCEBOOKS:

3. David Hanes, Gonzalo Salgueiro ,Patrick Grossetete, Rob Barton ,Jerome Henry,”IoT Fundamentals Networking Technologies ,Protocols and Use Cases for the Internet of Things”,Ciscopress.com, Person India Education Services Pvt Ltd.ISBN 978 81 7371 9547.
4. Adrian McEwen ,Hakim Cassimally “Designing he Internet of Things”,WILEY Indian Pvt Ltd. ISBN:978-81-265-5686-1.

JOURNALS/MAGAZINES

5. https://link.springer.com/article/10.1007/s11227-018-2652-7
6. https://journalofcloudcomputing.springeropen.com/
7. https://ieeexplore.ieee.org/document/7600359
8. https://www.ijedr.org/papers/IJEDR1902052.pdf

SWAYAM/NPTEL/MOOCs:

3. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
4. IoT (Internet of Things) Wireless & Cloud Computing Emerging Technologies -Coursera

SELF-LEARNINGEXERCISES:

Data Analytics for IoT, Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture,Productivity Applications Setting up a personal Blynk server, Controlling a Robot with Blynk.

Course Title	Big Data Analytics				Course Type		Theory	
Course Code	B20EA0601	Credits	4		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW

This course provides practical foundation level training that enables immediate and effective participation in big data projects. The course provides grounding in basic and advanced methods to big data technology and tools, including Hadoop and Spark.

COURSE OBJECTIVE (S):

1. Explain the concepts of Big Data and its Business Implications.
2. Describe the framework for Scala and Spark for Big-Data Analytics.
3. Discuss the use of features of Apache Spark for Data Analytics.
4. Demonstrate solving of Business Problems with Machine Learning in Spark and Scala

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make us of the concepts of Big Data in real world application.	1,2,3,4,5,9,12	2
CO2	Apply the theories of Hadoop in Scala for Big Data Analytics.	1,2,3,4,5,9,12	2
CO3	Design a Data Analytics Framework using Apache Spark with Scala.	1,2,3,4,5,9,12	1
CO4	Develop a real world application using Apache Spark with Scala.	1,2,3,4,5,9,12	1
CO5	Learn new tools and technologies in the big data analytics and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the big data analytics to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	2					1			3		3	
CO2	3	3	3	3					1			3		3	
CO3	3	3	3	3					1			3	3		
CO4	3	3	3	3					2			3	3		
CO5	3	3		3									3		
CO6	3	3		3								3		3	

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

COURSE CONTENT

THEORY

UNIT-1
The Age of the Data Product: What Is a Data Product?, Building Data Products at Scale with Hadoop, Leveraging Large Datasets, Hadoop for Data Products, The Data Science Pipeline and the Hadoop Ecosystem, Big Data Workflows. **An Operating System for Big Data**: Basic Concepts, Hadoop Architecture, A Hadoop Cluster, HDFS, YARN, Working with a Distributed File System, Basic File System Operations, File Permissions in HDFS, Other HDFS Interfaces, Working with Distributed Computation,
UNIT-2
MapReduce: A Functional Programming Model, Implemented on a Cluster, Beyond a Map and Reduce: Job Chaining, Submitting a MapReduce Job to YARN. **Scala Programming:** Functional Programming Aspects, What Is Functional Programming? Scala Programming Features, Functional Programming Aspects of Scala.
UNIT-3

Introduction to Apache Spark and Spark Core: What Is Apache Spark?, Why Apache Spark?, Spark vs. Hadoop MapReduce, Apache Spark Architecture, Spark Components, Spark Shell. **Spark Core:** RDD, RDD Transformations, RDD Actions, Working with Pair RDDs, Direct Acylic Graph in Apache Spark, Persisting RDD Shared Variables, Simple Build Tool (SBT).
UNIT-4 **Spark SQL, DataFrames, and Datasets**: What Is Spark SQL?, Spark Session, Creating DataFrames. **Introduction to Spark Streaming:** Data Processing, Streaming Data, Introduction to Spark Streaming, Spark Streaming Example Using TCP Socket, Stateful Streaming, Streaming Applications Considerations. **Spark Machine Learning Library:** What Is Spark MLlib?, Spark MLlib APIs, Vectors in Scala, Basic Statistics, Extracting, Transforming, and Selecting Features, ML Pipelines.

PRACTICE:

Sl. No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
	PART-A		
1	The ages of the couples are to be read and stored in a database called “ages”. It is required to classify number of couples belonging to 31..40, 41..50, 51..60 and 61..70. Write a Scala program to read the data from the “ages” and classify the ages of couples as mentioned in the above requirement.	Array	Illustrate, Implement, Apply
2	“DataTube”, a data collecting agency stores the last 4 characters in given file in uppercase. Write a Scala program to accomplish the solution for the above requirement.	Strings	Illustrate, Implement, Apply
3	“Avron” manufacturing company has a requirement of comparing the two names of their products lexicographically. Write a Scala program to provide the solution for the above requirement. Note: The two strings are lexicographically equal, if they are of same length and contain the same characters in the same positions.	Lexicography	Illustrate, Implement, Apply
4	“GESE”, a gene-sequencing company has a requirement to find the maximum occurring characters in a sequence prior to any other types of analysis. Write a Scala program to provide the solution for the above requirement.	Genesequencing	Illustrate, Implement, Apply
5	“Jesica”, a gene-sequencing company has a requirement to check if two given sequences are rotations of each other. (Note: ABCDA and CDAAB are	Strings, Functions	Illustrate, Implement, Apply

	rotations of each other) Write a Scala program to provide solution for the above requirement.		
6	Create a RDD in Scala through external source (text file) offering a Hadoop Input Format. "keywords.txt" file has the following 4 lines given below. Apache Spark Big Data and Analytics using Spark Learning Spark Real time Spark Streaming Machine Learning using Spark Spark using Scala Perform the following operations of the RDD created: a) Calculate the length (number of characters) of each line in "keywords.txt" using "map" transformation. b) Count the number of lines in RDD "lines" using "count" action. c) Find the sum of total number of characters in text.txt using "reduce" action	RDD	Illustrate, Implement, Apply
7	Create a RDD in Scala through external source (text file) offering a Hadoop Input Format. "keywords.txt" file has the following 4 lines given below. Apache Spark Big Data and Analytics using Spark Learning Spark Real time Spark Streaming Machine Learning using Spark Spark using Scala Perform the following operations of the RDD created: a) Calculate frequency of each word in "text.txt" using "flatMap" and "reduceByKey" actions. b) Filter out the words in "text.txt" whose length is more than 5 using "filter" transformation.	RDD	Illustrate, Implement, Apply
8	Create a DataFrame using a csv file "people.csv" having the following content, year, name, country, count 2015,john,us,215 2016,jack,ind,120 2017,james,ind,56 2018,john,cannada,67 2016,james,us,218	Dataframe, Filtering Transformation	Illustrate, Implement, Apply

	and perform the following analytics operations on that a) Create an RDD using people.csv. b) Use the filter(func) transformation to remove the header line.		
9	Create a DataFrame using a csv file "people.csv" having the following content: year,name,country,count 2015,john,us,215 2016,jack,ind,120 2017,james,ind,56 2018,john,cannada,67 2016,james,us,218 Perform the following analytics operations on that a) Use map(func) and the split() method to split fields by ",". b) Retrieve country, name field using map(func). c) Apply groupByKey to group names by each country.	Dataframe, MapReduce	Illustrate, Implement, Apply
10	Write Scala code to count the occurrence of each word in a file shown in a csv file "people.csv" of Q5.	RDD, Dataframe	Illustrate, Implement, Apply, Analyze
11	Create the data (IP Address, URL and Location) as logdata.log with comma delimiters. Perform the following operations: a) Create an RDD from the created file with the column names as specified by using the schema inference through reflection method. b) Create a DataFrame from the created RDD and register it as a global temporary view named LogDetails_Global.	RDD, Dataframe	Illustrate, Implement, Apply, Analyze
12	Create the data (IP Address, URL and Location) as logdata.log with comma delimiters. Perform the following operations: a) Write a SQL query to find the number of unique IP addresses in each location. b) Save the DataFrame created in Question 3 as a json file, using the Spark write method by specifying the json format. c) Run the same SQL query to find the number of unique IP addresses in each location directly on the json file created without creating a DataFrame.	RDD, Dataframe, SQL	Illustrate, Implement, Apply, Analyze
PART-B: Mini-Project Title **Health care: Data set on Heart attack possibility**			

Problem Statement: To analyze the Heart disease data set in order to predict Heart Attack possibility for a patient.

It is required to analyze the Heart disease data set in order to predict Heart Attack possibility for a patient. Download the data set from the link:https://archive.ics.uci.edu/ml/datasets/Heart+Disease
and perform the following:

1. **Import**ing of the data from given link the Data Set
2. **Data Cleaning:** Address the data inconsistencies, such as missing values and any redundant variables.
3. **Data Exploration**: boxplots and qplots, are to be plotted to understand the significance of each predictor variables.
4. **Data Modelling**: Build a Classification model using suitable classification algorithm.
5. **Validate the model**: Efficiency of the data model is to be evaluated by using the testing data set.

About data set:
This database contains 76 attributes. The "target" field refers to the presence of heart disease in the patient. It is integer valued 0 = no/less chance of heart attack and 1 = more chance of heart attack. Data set download Link: https://archive.ics.uci.edu/ml/datasets/Heart+Disease

Attribute Information about patient:
1) age
2) sex
3) chest pain type (4 values)
4) resting blood pressure
5) serum cholestoral in mg/dl
6)fasting blood sugar > 120 mg/dl
7) resting electrocardiographic results (values 0,1,2)
8) maximum heart rate achieved
9) exercise induced angina
10) oldpeak = ST depression induced by exercise relative to rest
11)the slope of the peak exercise ST segment
12) number of major vessels (0-3) colored by flourosopy
13) thal: 0 = normal; 1 = fixed defect; 2 = reversable defect
14) target: 0= less chance of heart attack 1= more chance of heart attack

By studying the dependency of these predictor variables on the response variable, you can predict or forecast sales for the upcoming months.

TEXT BOOKS:

1. Sridhar Alla, “Big Data Analytics with Hadoop 3”, published by Packt Publishing Ltd, May 2018
2. SubhashiniChellappan, DharanitharanGanesan,” Practical Apache Spark Using the Scala API”, A Press, 2018.

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.

4. IEEE,Introduction to the IEEE Transactions on Big Data
5. Elsevier, Big data research journal Elsevier
6. Springer, Journal on Big Data Springer.
7. ACM DL,The Journal of Machine Learning Research-ACM

JOURNALS/MAGAZINES:

1. https://www.journals.elsevier.com/big-data-research
2. Springer, Big data analytics: a survey
3. Springer, Big Data Analytics
4. Data Science and Analytics,https://www.springer.com/journal/41060

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
2. Introduction to Big data-Coursera

SELF LEARNING EXERCISES:

Spark Real-Time Use Case: Data Analytics Project Architecture, Data Ingestion, Data Storage, Data Processing, Data Visualization

Course Title	Text and Web Mining (PE-II)				Course Type		Theory	
Course Code	B20EKS601	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course in web and text data mining covers basic concepts and techniques of the data mining and application of these techniques in text data and web data for various types of analysis. The course also introduces some research topics which can be used for implementation in projects.

COURSE OBJECTIVE (S):

1. Discuss various data mining techniques for different applications.
2. Describe different clustering techniques for text data.
3. Demonstrate the classification techniques for text data.
4. Illustrate web data retrieval techniques.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Choose the Data mining techniques to extract data from given dataset.	1,2,3,4,5	1
CO2	Apply appropriate classification algorithm to analyze the given data.	1,2,3,4,5	1
CO3	Identify suitable Web Mining technique to perform social network analysis.	1,2,3,4,5	1
CO4	Design web crawlers for information retrieval from web.	1,2,3,4,5	2, 3
CO5	Learn new tools and technologies in the text and web mining and professional ethics and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the text and web mining to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	3								3		
CO2	2	3	1	2	1								3		
CO3	2	1	1	2	1								3		
CO4	2	2	1	3	3									3	3
CO5	2	2		3	3										
CO6		2	1	3	3									3	3

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

COURSE CONTENT

THEORY

UNIT-1
Introduction to Data Mining Techniques: Text Extraction and Document Clustering. Introduction to data mining, Classification, Clustering, Association Analysis, Introduction to key extraction methods, Rapid automatic keyword extraction, Benchmark evaluation, Stoplist generation, Evaluation on news articles, Algebraic techniques for multilingual document clustering: Introduction, Experimental setup, Multilingual LSA.
UNIT-2
Text Data Classification: Content-based spam email classification using machine-learning algorithms: Introduction, Naive Bayes, LogitBoost, Support vector machines, Augmented latent semantic indexing spaces, Radial basis function networks, Data pre-processing, Feature selection, Message representation Evaluation of email classification, Utilizing nonnegative matrix factorization for email classification problems: Introduction, Nonnegative matrix factorization.
UNIT-3
Web Mining - I: Information Retrieval and Web Search:Basic Concepts of Information Retrieval,Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Link Analysis: Social Network Analysis, Co-Citation and Bibliographic Coupling.
UNIT-4
Web Mining - II:Web Crawling: A Basic Crawler Algorithm: Breadth-First Crawlers, Preferential Crawlers, Implementation Issues: Fetching, Parsing, Stop word Removal and Stemming Link Extraction and Canonicalization, Spider Traps, Page Repository, Concurrency, Universal Crawlers: Scalability, Coverage vs Freshness vs Importance, Focused Crawlers, Topical Crawlers: Topical Locality and Cues.

TEXT BOOKS:

1.Michael W. Berry and Jacob Kogan, “Text Mining: Applications and Theory”, Wiley, 2010

2.Bing Liu, “Web DataMining: Exploring Hyperlinks, Contents and Usage Data”, springer, 2007.

REFERENCES BOOKS:

1.Jiawei Han, MichelineKamber, Jian Pei, “Data Mining: Concepts and Techniques”, Elsevier, 2011.

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

3.IEEE Transactions on Knowledge and Data Engineering.

JOURNALS/MAGAZINES:

1. https://ieeexplore.ieee.org/document/1306945, Web mining : research and practice
2. https://www.ijert.org/a-review-on-web-mining
3. https://arxiv.org/ftp/arxiv/papers/1304/1304.3563.pdf

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/105/106105174/
2. Data mining Specialization-Coursera

SELFLEARNING EXERCISES:

PageRank for Social network analysis and Focused Crawlers

Course Title	High Performance Computing (PE-II)				Course Type		Theory	
Course Code	B20EKS602	Credits	3		Class		VIsemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW

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

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the features of Modern processors and parallel computers
2. Describe different levels of parallelism along with the synchronization and scheduling
3. Demonstrate the use of features of OpenMP programming.
4. Illustrate the use of features of Open MPI programming.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify different levels of parallelism that can be applied to solve the given real world problems.	1,2,3,4,5, 9 ,12	1,2
CO2	Develop the programs using different levels of parallelism to solve the real world problems.	1,2,3,4, 9 ,12	1,2
CO3	Make use of features of OpenMP to develop parallel programs for solving	1,2,3,4,5, 9 ,12	3
CO4	Apply the features of Distributed-memory parallel programming with openMPI for solving real world problems.	1,2,3,4,5, 9 ,12	3
CO5	Learn new tools and technologies in the high performance computing and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the high performance computing to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	2				3			1	3	3	
CO2	3	2	1	1					3			1	3	3	
CO3	3	2	2	2	2				3			1			3
CO4	3	2	2	2	3				2			2			3
CO5	3	2	2		3							2			3
CO6	3	2	2									2			3

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

COURSE CONTENT

THEORY

CONTENTS
UNIT-1
Modern Processors: Stored-program computer architect; General-purpose cache-based microprocessor architecture Memory hierarchies; Multicore processors; Multithreaded processors; Vector processors. Parallel computers: Taxonomy of parallel computing paradigms; Shared-memory computers; Distributed-memory computers; Hierarchical (hybrid) systems; Networks.
UNIT-2
Basics of parallelization: Why parallelize; Parallelism; Parallel scalability.
UNIT-3
Shared-memory parallel programming with OpenMP: Introduction to OpenMP; Case study: OpenMP-parallel Jacobi algorithm; Advanced OpenMP: Wavefront parallelization. Efficient OpenMP programming: Profiling OpenMP programs; Performance pitfalls; Case study: Parallel sparse matrix-vector multiply.
UNIT-4
Distributed-memory parallel programming with MPI: Message passing; A short introduction to MPI; Example: MPI parallelization of a Jacobi solver. Efficient MPI programming: MPI performance tools; Communication parameters; Synchronization, serialization, contention; Reducing communication overhead; Understanding intranode point-to-point communication.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. .Rohit Chandra , Leo Dagum , DrorMaydan , David Kohr, Jeff McDonald , Ramesh Menon,"Parallel Programming in OpenMP",Morgan Kaufmann,2000
2. Shameem Akhter and Jason Roberts 6,"Multi-core programming,Increase performance through software multiyhreading", IEEE Transactions on Knowledge and Data Engineering.
3. Kai Hwang ",Advanced Computer Architecture: Parallelism, Scalability, Programmability", TATA McGraw Hill, 1993
4. George S. Almasi and Alan Gottlieb,"Highly Parallel Computing".
5. AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar ,"Introduction to Parallel Computing", Addison-Welsey,2003.

JOURNALS/MAGAZINES:

1. https://journals.sagepub.com/home/hpc
2. https://dl.acm.org/journal/sage-hpca
3. Springer, https://link.springer.com/book/10.1007/978-3-319-20119-1
4. Springer,https://www.springer.com/gp/book/9780792383406

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/108/106108055/
2. Introduction to High-Performance and parallel computing-Coursera

SELF- LEARNING EXERCISES:

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

<table>
<tr><td>Course Title</td><td colspan="4">Distributed & Parallel systems (PE-II)</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>B20EKS603</td><td>Credits</td><td colspan="2">4</td><td colspan="2">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 colspan="2" rowspan="2">Total Number of Classes Per Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>-</td><td>-</td><td>-</td><td>Theory</td><td>Practical</td><td>CIE</td><td>SEE</td></tr>
<tr><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>-</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW

The students will gain an understanding of the principles and techniques behind the design of distributed and parallel systems, such as, synchronization and communication across networks. Students will gain practical experience in designing, implementing, and debugging real time distributed systems. The major themes this course will teach include process distribution and communication, data distribution, scheduling, memory sharing, distributed synchronization models, distributed file systems.

COURSE OBJECTIVE (S):

The objectives of this course are to:

- To learn the principles, architectures, algorithms and programming models used in distributed and parallel systems.
- To examine state-of-the-art distributed systems.
- To design and implement sample distributed systems.

COURSEOUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Understand the requirements for distributed and parallel systems and how they can be used to facilitate the programming of concurrent systems.	1-5,8,9,12	1
CO2	Acquire knowledge of distributed and parallel system techniques, methodologies and Algorithms	1-5,8,9,10	1
CO3	To apply the knowledge of distributed and parallel systems algorithms	1-6,8,9,10,12	1
CO4	Understand the memory hierarchy and cost-performance tradeoffs.	1-6,9,10	1
CO5	To learn the knowledge of synchronization and process management	1-5,8,9,11	2

CO6	To gain experience in the design, development, and performance analysis of distributed and parallel applications	1-6,8-12	2

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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	0	0	2	2	0	0	3	3	0	0
CO2	3	3	2	3	3	0	0	3	3	2	0	0	3	0	0
CO3	3	3	3	2	3	2	0	3	2	3	0	3	3	0	0
CO4	3	3	3	2	2	3	0	0	3	3	0	0	3	0	0
CO5	3	2	3	3	3	0	0	3	3	0	2	0	0	3	0
CO6	3	3	3	3	3	2	0	3	2	3	2	2	0	3	0

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

COURSE CONTENT

UNIT-1

Distributed Systems: Definition, Issues, Goals, Types, Models, Hardware concepts, Software Concept, Client Server model. Communication: Layered Protocols, Remote Procedure Call, Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication.

UNIT-2

Process in Distributed System: Threads, Scheduling, Fault Tolerance, Real Time distributed System

Synchronization: Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm,

Token Based Algorithms: Suzuki-Kasami's Broardcast, Singhal's Heurastic, Raymond's Tree based **Non Token based Algorithms:** Lamport, Ricart–Agrawala's, Maekawa's Algorithm.
UNIT-3
Shared Memory: on chip memory, Bus Based multi processor, Ring based multi processor, switched processor, Numa Multi processor. Page Based Distributed Shared Memory, Shared Variable Distributed Shared Memory, Object based Distributed Shared Memory **Distributed File System:** File models, File Accessing models, File-Caching Schemes, Replication, Network File System (NFS).
UNIT-4
Parallel Systems: Parallel Computing; Parallel Architecture, Classifications, Performance Metrics, Parallel Programming Models, Serial and Parallel Algorithms; Pipelining: Types, Design, Hazards; SIMD: Architecture and Programming Principles, SIMD Parallel Algorithms, Data Mapping and memory in array processors, Case studies of SIMD parallel Processors.

TEXTBOOKS:

4. A.S.Tanenbaum, M.Van Steen, "Distributed Systems", Pearson Education, 2004.
5. Parallel and Distributed Systems, 2ed, Arun Kulkarni, Nupur Prasad Giri, Nikhilesh Joshi, Bhushan Jadhav ISBN: 9788126565825.

REFERENCEBOOKS:

8. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Third Edition, Pearson Education Asia, 2002.
9. Andrew S. Tannenbaum and Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Pearson, 2007.
10. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, "Distributed Systems: Concepts and Design", Fifth Edition, Addison Wesley, 2011.
11. James E. Smith, and Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", First Edition, Morgan Kaufmann, 2005.
12. Fault-Tolerant Parallel and Distributed Systems, Dimiter R. Avresky, David R. Kaeli (auth.) ISBN: 9781461554493, Springer US, 1998.

JOURNALS/MAGAZINES

1. IEEE Transactions on Parallel and Distributed Systems (https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=71)
2. International Journal of Parallel, Emergent and Distributed Systems (https://www.tandfonline.com/toc/gpaa20/current)
3. International Journal of Distributed Systems and Technologies (igi-global.com/journal/international-journal-distributed-systems-technologies/1164)

SWAYAM/NPTEL/MOOCs

4. https://onlinecourses.nptel.ac.in/noc21_cs87
5. https://www.coursera.org/courses?query=distributed%20systems
6. https://www.mooc-list.com/tags/distributed-computing

Course Title	Block Chain Technology (PE-II)				Course Type		Theory	
Course Code	B20EJS604	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Block chain is the distributed and decentralized database technology behind this crypto currency. This course explores the fundamentals of the public, transparent, secure, immutable and distributed database called block chain. Block chains can be used to record and transfer any digital asset not just currency. This course will introduce students to the workings and applications of this potentially disruptive technology. Its potential impact on financial services, government, banking, contracting and identity management.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe the basic concepts of Cryptography and Blockchain technology.
2. Explain the features of Ethereumblockchain technology, decentralised applications and smart contract.
3. Demonstrate building of decentralised applications by deploying Smart Contracts
4. Analyze different Blockchain Platforms that can be used in real world applications.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the concepts of Blockchain technology suitable for given real world application.	1,2,3,4,5, 12	1
CO2	Compare the performance of POW and POS mining consensus algorithm with respect to given real world application..	1,2,3,4,5, 12	1
CO3	Build a decentralised application by implementing smart contract using solidity programming language.	1,2,3,4,5, 12	2
CO4	Apply various blockchain platforms for solving real world problems.	1,2,3,4,5, 12	2,3
CO5	Learn new tools and technologies in the introduction to data mining techniquesand apply for suitable application development.	12	1, 2

CO6	Develop solutions in the introduction to data mining techniques to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

BLOOM'S LEVELOF THECOURSE 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	2	2	2	2	2							1	3		
CO2	3	3	2	3	2							1	3		
CO3	2	3	3	2	2							1		3	
CO4	2	3	3	2	2							1		3	3
CO5	2	3		2	2									3	
CO6		3		2										3	3

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

COURSE CONTENT

THEORY

UNIT-1

Introduction to cryptography and Blockchain: Introduction to cryptography-Symmetric- key cryptography, Public-key cryptography, Digital Signatures and Elliptic Curve Cryptography. Introduction to Blockchain: Types of Blockchain, Structure of a Block, BlockHeader, Block Header Hash and Block Height, Genesis Block, Linking Blocks in the Blockchain, Merkle Trees, Constructing the Block Header. Introduction to tools: solidity, Geth and Mist.

Mining and Consensus: The Byzantine general's Problem, Consensus mechanism-proof of work & proof of stake, Bitcoin mining and Blockchain Forks

UNIT-2
Overview of Ethereum: What Is Ethereum? Compared to Bitcoin, Ethereum: A General-Purpose Blockchain, Ethereum Accounts (Externally Owned Accounts and Contracts), Ethereum and Turing Completeness, Decentralized Applications, Decentralized Autonomous Organizations, Smart Contract Introduction, Life Cycle of a Smart Contract.
UNIT-3
Dapp development on Ethereum: Programming Solidity: Structure, Basic Data Types & Statements, Specific Data Types, Data Structures, Memory vs Storage, Access Modifiers, Contract Definition, Functions, Contract Constructor, The Ethereum Contract ABI, Events, Run EthereumDapps, Develop a simple smart contract.
UNIT-4
Enterprise Blockchains and Applications: Enterprise Blockchains: Hyperledger, R3 Corda, **QuorumBlockchain Applications:** Identity management, Auction, Food industry supply chain and Blockchain in Health care.

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TEXT BOOKS:

1.Joseph J. Bambara Paul R. Allen," Blockchain,A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill Education Professional , Second edition, 2018

2.Melanie Swan "Blockchain: Blueprint for a New Economy", O'Reilly Media, Third edition, Aug 2015.

3.Andreas M. Antonopoulos, Gavin Wood "Mastering Ethereum", O'Reilly Media, Inc., November 2018

4.Joseph Holbrook "Architecting Enterprise Blockchain Solutions", Sybex, February 2020

REFERENCE BOOKS:

1.Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smartcontracts" Packt , 2nd edition 2018.

2.Jimmy Cooper,"Blockchain Blueprint: Guide to Everything You Need to Know About Blockchain Technology and How It Is Creating a Revolution ",CreateSpace Independent Publishing Platform, 2017.

3.Deepak Puthal; Nisha Malik; Saraju P. Mohanty; Elias Kougianos; Chi Yang "The Blockchain as a Decentralized Security Framework [Future Directions]" Volume: 7, Issue: 2 , Pages: 18 – 21,Year: 2018.

4.ValentinaGatteschi; FabrizioLamberti; Claudio Demartini; Chiara Pranteda; Víctor Santamaría" To Blockchain or Not to Blockchain: That Is the Question "Volume: 20, Issue: 2 Pages: 62 - 74 ,2018.

5.Tien Tuan Anh Dinh; Rui Liu; Meihui Zhang; Gang Chen; Beng Chin Ooi; Ji Wang "Untangling Blockchain: A Data Processing View of Blockchain Systems" , Volume: 30, Issue: 7 ,Pages: 1366 – 1385 , Year: 2018.

6.Mingjun Dai; Shengli Zhang; Hui Wang; Shi Jin "A Low Storage Room Requirement Framework for Distributed Ledger in Blockchain" Volume: 6, Pages: 22970 – 22975, Year: 2018.

7.Ruiguo Yu, Jianrong Wang, Tianyi Xu, Jie Gao Yongli An Gong Zhang, And Mei Yu "Authentication With Block-Chain Algorithm and Text Encryption Protocol in Calculationof Social Network ",Volume: 5,pp: 24944 – 24951, 09 November 2017.

8.AshiqAnjum; Manu Sporny; Alan Sill " Blockchain Standards for Compliance and Trust" , Volume: 4, Issue: 4 ,Pages: 84 – 90,Year: 2017.

9.Morgen E. Peck; Samuel K. Moore “The blossoming of the blockchain” , Volume: 54, Issue: 10 Pages: 24 – 25, Year: 2017.

JOURNALS/MAGAZINES:

1. Ledger Journal of Cryptocurrency and Blockchain Technology.
2. Inderscience Journal of blockchain and cryptocurrency.
3. https://link.springer.com/bookseries/16276
4. https://www.springer.com/gp/book/9789811387746

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/104/106104220/lock
2. Chain Specialization,Introduction to Block Chain Technologies -Coursera

SELF-LEARNING EXERCISES:

Distributed Ledger inBlockchain, Decentralized Applications.

Course Title	System-on-Chip Design (PE-II)				Course Type		Theory	
Course Code	B20EKS605	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

The course tells about the basics of system on chip. It discusses the fundamentals of system on chip design with introduction to the different processor and memory structures. It also briefs about the different interconnection mechanism used in system on chip

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Learn the basics of system on chip design.
2. Study the different types of processors that are used in the concept system on chip.
3. Look into the different types of memory used in the system on chip design.
4. Understand the different interconnection mechanism used in system on chip based design.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Summarize the basic design of a system on chip-based design.	1,2,3,4,5	1,3
CO2	Classify the different processors used in a system on chip-based design.	1,2,3,4,5	1,3
CO3	Make use of the different memory technologies used in the concept of	1,2,3,4,5	1,3
CO4	Categorize the basic interconnection mechanism in a system on chip	1,2,3,4,5	1,3
CO5	Understand IP cores and application specific design	9,11,12	2,3
CO6	Appreciate issues in system-on-chip design associated with co-design, such as intellectual property, reuse, and verification.	1,2,3,4,5	1,3

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	3	3								3		3
CO2	2	3	3	3	3								3		3
CO3	2	3	3	3	2								3		3
CO4	2	3	2	3	2								3		3
CO5									2		3	3			3
CO6	2	3	2	3	2								3		3

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

COURSE CONTENT

THEORY

UNIT-1
Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.
UNIT-2
Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.
UNIT-3
Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.
UNIT-4
Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. **SOC Customization**: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

TEXTBOOKS:

1. Michael J. Flynn and Wayne Luk, “Computer System Design System-on-Chip”, Wiley India Pvt. Ltd.
2. Steve Furber, “ARM System on Chip Architecture “, 2nd Edition, 2000, Addison Wesley Professional.

REFERENCE BOOKS:

1. Ricardo Reis, “Design of System on a Chip: Devices and Components”, 1st Edition, 2004, Springer
2. Jason Andrews, “Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)”, Newnes, BK and CDROM.
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, “System on Chip Verification – Methodologies and Techniques”, 2001, Kluwer Academic Publishers.

JOURNALS/MAGAZINES

1. IEEE Embedded Systems Letters

2. IEEE Transactions on Computer-Aided Design of Integrated Circuits &Systems
3. IEEE Transactions on Very Large Scale Integration (VLSI)Systems
4. IEEE Transactions on Circuits and Systems II: Express Briefs

SWAYAM/NPTEL/MOOCs:

1. Advanced Computer Architecture : NPTEL
2. Introduction to FPGA Design for Embedded Systems :Coursea
3. Hardware Description Languages for FPGA Design :Coursea

SELFLEARNINGEXERCISES:

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

Course Title	Neural Networks and Deep learning (PE-II)				Course Type		Theory	
Course Code	B20EJS606	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

Neural Networks are an effective programming paradigm that enable a computer to learn from observed data. They simulate biological learning of the nervous system and have been demonstrated to increase the power of known machine learning models by stacking them as computational graphs. This is different from conventional programming where human programmers define the set of tasks to be carried out by a computer to solve a problem. Deep learning is a subset of machine learning that uses many layers of neural networks to accomplish tasks like image recognition, text procession, speech recognition, natural language processing etc. This course aims at giving the students the knowledge and the skills required to model the solutions to real world problems using neural networks and deep learning.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of neural network-based paradigm to problem solving.
2. Inculcate knowledge of concepts involved in training of neural networks.
3. Discuss the concepts and issues in deep neural networks.
4. Explain generalizability of deep neural networks and introduce prominent deep neural architectures.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the fundamental architecture of neural network and the concepts involved.	1,2,3,4,5	1,2
CO2	Apply the shallow neural network models - Perceptron, Least-Squares Regression, Logistic Regression, Support Vector machines to solve real	1,2,3,4,5	1,2
CO3	Develop simple deep neural networks to solve problems in unsupervised learning.	1,2,3,4,5	1,3
CO4	Create deep neural models like CNN and RNN to solve problems.	1,2,3,4,5	1,3
CO5	Illustrate the applications of CNN for solving real world Problems	1,2,3, 11, 12	1,3
CO6	Illustrate the applications of CNN for solving real world Problems	1,2,3, 11, 12	1,3

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	2	1								2	2	
CO2	3	2	3	1	2								2	2	
CO3	3	1	2	1	2								2		2
CO4	3	2	2	2	2								2		2
CO5	3	2	2								1	1			
CO6	3	2	3								1	1			

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

COURSE CONTENT

THEORY

UNIT-1
Introduction to Neural Networks: The basic architecture of Neural Networks – Single computational layer – The Perceptron, What Objective Function Is the Perceptron Optimizing? , Relationship with Support Vector Machines Choice of Activation and Loss Functions, Some Useful Derivatives of Activation Functions Choice and Number of Output Nodes multilayer neural network, The Multilayer Network as a Computational Graph, Training a Neural Network with Backpropagation, Practical Issues in Neural Network Training -The Problem of Overfitting, The Vanishing and Exploding Gradient Problems **Common Neural Architectures** - Simulating Basic Machine Learning with Shallow Models, Radial Basis Function Networks, Restricted Boltzmann Machines, Recurrent Neural Networks, Convolutional Neural Networks, Two Notable Benchmarks - The MNIST Database of Handwritten Digits, The ImageNet Database
UNIT-2
Machine Learning with Shallow Neural Networks - Neural Architectures for Binary Classification - Revisiting the Perceptron, Least-Squares Regression, Logistic Regression, Support Vector machines, Neural Architectures for Multiclass Models - Multiclass Perceptron, Weston-Watkins SVM, Multinomial Logistic Regression (Softmax Classifier), Hierarchical Softmax for Many Classes, Auto encoder: Basic Principles, Nonlinear Activations, Deep Auto encoders, Application to Outlier Detection, When the Hidden Layer Is Broader than the Input Layer, Word2vec: An Application of Simple Neural Architectures, Simple Neural Architectures for Graph Embeddings
UNIT-3
Deep Neural Networks – Introduction, Backpropagation - Backpropagation with the Computational Graph Abstraction, Backpropagation with Post-Activation Variables, Backpropagation with Pre-activation Variables, Examples of Updates for Various Activations, Loss Functions on Multiple Output Nodes and Hidden Nodes, Setup and Initialization Issues - Tuning Hyper-parameters, Gradient-Descent Strategies- Learning Rate Decay, Momentum-Based Learning -Nesterov Momentum, Parameter-Specific Learning Rates –AdaGrad, RMSProp, Adam, Gradient Clipping, Second-Order Derivatives, Batch Normalization.
UNIT-4
Prominent Deep Learning Models - **Restricted Boltzmann Machines** – The Boltzmann Machine, How a Boltzmann. Teaching Deep Learners to Generalize- The Bias-Variance Trade-Off, Generalization Issues in Model Tuning and Evaluation, Issues with Training at Scale, Penalty-Based Regularization - L1-Regularization, L1- or L2-Regularization, Penalizing Hidden Units: Learning Sparse Representations, Ensemble Methods-Bagging and Subsampling, Parametric Model Selection and Averaging, Randomized Connection Dropping, Dropout, Data Perturbation Ensembles, Early Stopping.

Prominent Deep Learning Models - **Restricted Boltzmann Machines** – The Boltzmann Machine, How a Boltzmann Machine Generates Data, Training the RBM, **Recurrent Neural Networks** - The Architecture of Recurrent Neural Networks, Long Short-Term Memory (LSTM), **Convolutional Neural Networks** - The Basic Structure of a Convolutional Network Training a Convolutional Network, **Deep Reinforcement Learning** - The Basic Framework of Reinforcement Learning

TEXTBOOKS:

1. Charu Aggarwal, "Neural Networks and Deep Learning", Springer, 2018.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press

REFERENCEBOOKS:

1. Francis Chollet, "Deep Learning with Python", Manning, 2018.
2. Jacek M. Zurada, Introduction to Artificial Neural Systems, PWS Publishing Company, 1995.
3. Simon Haykin, Neural Networks: A Comprehensive Foundation, Macmillan College Publishing Company, 1994.
4. Mohamad H. Hassoun, Fundamentals of Artificial Neural Networks, The MIT Press, 1995.
5. LaureneFausett, Fundamentals of Neural Networks: Architectures, Algorithms, and Applications, Prentice Hall International, Inc., 1994.
6. B. D. Ripley, Pattern Recognition and Neural Networks, Cambridge University Press. 1996.

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and Learning Systems https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5962385
2. IEEE Transactions on Pattern Analysis and Machine Intelligence
3. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=34http://ijaerd.com/papers/special_papers/IT032.pdf
4. International Journal of Intelligent Systems https://onlinelibrary.wiley.com/journal/1098111x
5. http://www.charuaggarwal.net/neural.htm
6. http://neuralnetworksanddeeplearning.com/
7. https://github.com/mnielsen/neural-networks-and-deep-learning
8. deeplearning.stanford.edu
9. http://yann.lecun.com/exdb/mnist/
10. University of California Irvine Machine Learning Repository - https://archive.ics.uci.edu/ml/datasets.php
11. https://peterroelants.github.io/posts/rnn-implementation-part01/
12. https://victorzhou.com/blog/keras-rnn-tutorial/

SWAYAM/NPTEL/MOOCs:

1. SwayamNptel – Deep Learning – IIT Ropar https://onlinecourses.nptel.ac.in/noc21_cs35/preview
2. Coursera – Neural Networks and Deep Learning Andrew Ng
3. Coursera - Neural Networks for Machine Learning by Geoffrey Hinton in Coursera

Course Title	Computer Vision and Applications (PE-III)				Course Type		Theory	
Course Code	B20EJ607	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	3	3	3	39	0	50	50

COURSE OVERVIEW

Computer Vision is one of the fastest growing and most exciting AI disciplines in today's academia and industry. This course is designed to open the doors for students who are interested in learning about the fundamental principles and important applications of computer vision. 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.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of Computer vision.
2. Discuss various segmentation techniques and their applications.
3. Demonstrate the use of techniques for registration and classification of images.
4. Describe the object detection and recognition process in a given application.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Utilize linear filters to enhance the quality of images in given real world application	1,2,3,4,5	1,2
CO2	Develop Segmentation technique to solve real world problems.	1,2,3,4,5	1,2
CO3	Design and Develop program for registration and classification of images in the real world application Compare the various performance of protocols used	1,2,3,4,5	1,2
CO4	Apply object detection and recognition techniques to solve real world problems.	1,2,3,4,5	1,2
CO5	Learn new tools and technologies in the Computer Vision and Applications and apply for suitable application development.	12	2

CO6	Develop solutions in the related field ofComputer Vision and Applications to the complex problems, either individually or as a part of the team and	5,9,10	2

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

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	3								3	3	
CO2	3	2	2	2	3								3	3	
CO3	3	2	3	3	3								3	3	
CO4	3	2	3	3	3								3	3	
CO5		2		3								2		2	
CO6	1				3				2	2				2	

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Introduction: What is computer vision? A brief history. Image formation: Geometric primitives and transformations, Geometric primitives, 2D transformations ,3D transformations, 3D rotations, 3D to 2D projections, Lens distortions, Photometric image formation, Lighting, Reflectance and shading, The digital camera, Sampling and aliasing, Color, Compression.
UNIT-2
Image processing, Point operators, Linear filtering, More neighbourhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations, Global optimization, Feature detection and matching ,Points and patches, Feature detectors , Feature descriptors, Feature matching, Feature tracking, Edges, Edge detection, Edge linking, Application: Edge editing and enhancement, Lines, Successive approximation, Vanishing points, Hough transforms, Application: Rectangle detection
UNIT-3
Segmentation : Active contours, Snakes, Dynamic snakes and CONDENSATION, Scissors, Level Sets, Application: Contour tracking and rotoscoping, Split and merge, Watershed, Region splitting (divisive clustering), Region merging (agglomerative clustering), Graph-based segmentation, Probabilistic aggregation, Mean shift and mode finding, Normalized cuts Graph cuts and energy-based methods.
UNIT-4
High-Level Vision Registration: Registering Rigid Objects, Model-based Vision: Registering Rigid Objects, Registering Deformable Objects .Learning to Classify: Classification, Error, and Loss, Major Classification Strategies, Practical Methods for Building Classifiers, Classifying Images: Building Good Image Features, Classifying Images of Single, Image Classification in Practice detecting Objects in Images: The Sliding Window Method, Detecting Deformable Objects, The State of the Art of Object Detection **Topics in Object Recognition**: What Should Object Recognition Do?.

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", 2nd Edition, University of Illinois at Urbana-Champaign Jean Ponce, Ecole Normale Superieure, Paris©2012, Pearson
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011
3. David Marr, Tomaso A. Poggio, Shimon Ullman "A Computational Investigation into the Human Representation and Processing of Visual Information", , eBook - Amazon.com

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES

1. International Journal of Computer Vision, Springer, https://www.springer.com/journal/11263
2. Image and Vision Computing, Elsevier, https://www.journals.elsevier.com/image-and-vision-computing

1. Computer Vision and Image Understanding, Elsevier, https://www.journals.elsevier.com/computer-vision-and-image-understanding
2. IEEE Transactions on Image Processing, https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=83
3. IEEE Transactions on Pattern recognition and machine intelligence, https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=34

SWAYAM/NPTEL/MOOCs:

1. https://www.coursera.org/courses?query=computer%20vision
2. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs58/

SELF-LEARNINGEXERCISES:

Artificial Neural Networks, Convolutional Neural Network.

Implementation of applications using the above topics.

Course Title	Advanced Topics in Wireless Networks (PE-III)				Course Type		Theory	
Course Code	B20EJS608	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course is aimed at equipping students with advanced concepts in wireless network theory and technologies, vital for a successful career in digital economy. Wireless communication is fast growing industry segments today. Many types of wireless networks are now being used for applications such as personal communication, entertainment, rural and urban healthcare, smart home building, inventory control, and surveillance. This course introduces the concepts of wireless networks and mobile computing to give engineering students at the undergraduate/graduate level a solid background in the field. It also looks at the latest research and challenging problems in the field to serve as a reference for advanced-level researchers.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of wireless network.
2. Gain bandwidth management and node localization in wireless networks
3. Describe the message communication in adhoc network and sensor nodes.
4. Discuss the communication optimization and security in wireless communication.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs

CO1	Identify the fundamentals of wireless communication concepts.	1,2,3, 4, 8, 9 , 12	1
CO2	Make use of bandwidth management concept in wireless networks	1 ,2,3, 5,9,12	2
CO3	Apply the knowledge of routing in wireless network for optimization	1 ,2,3,4 5, 9, 12	2
CO4	Develop an algorithm for energy efficient communication and secure transmission.	1,4,5,9,12	2
CO5	Design a component or a product applying all the relevant standards and with realistic constraints	6,7,9,10	2,3
C06	Design and conduct experiments, as well as to analyze and interpret data	6,7,9,10	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			√	√		
C05			√		√	
CO6				√	√	

COURSE ARTICULATION MATRIX

CO#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2				2	1			1	3		
CO2	3	2	3		3				1			1		3	

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1 **Introduction:** Applications Involving Wireless Communication, Effects of Mobility of Devices, Issues in Cellular Mobile Networks, Issues in Ad Hoc Networks, Issues in Cognitive Radio Networks, Issues in Sensor Networks **Mobility Management in Cellular Networks:** Call Setup in Public Land Mobile Networks, Call Setup in Mobile IP Networks, Handoff Management, Mobility Models
UNIT – 2 **Bandwidth Management in Cellular Networks:** Introduction, Benchmark Instances, Lower Bounds on Bandwidth, Genetic Algorithm for Channel Assignment, Coalesced CAP, Fast Near-Optimal Channel Assignment **Localization of Nodes in Mobile Networks :** System Model, Preliminaries, Estimation of Location Error, Beacon Nodes Selection Algorithm, Location Region Identification
UNIT – 3 **Messae Communication in Ad Hoc Networks:** Introduction, Broadcast in Ad Hoc Networks, Transmission Schedule, Slot Assignment based on Location Information, Deterministic Broadcast and Gossiping, Point-to-point Routing in Ad Hoc Networks, Destination-Sequenced Distance Vector Routing (DSDV) Protocol, Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector Routing (AODV), Temporally-Ordered Routing Algorithm (TORA), Zone Routing Protocol (ZRP)
UNIT – 4 **Energy-Efficient Communication:** Introduction, Some Elegant Physical Layer-Centric Techniques, Redundant Binary Number Encoding with Silent Zero Communication (RBNSiZeComm), Ternary with Silent Symbol (TSS) Communication Protocol, Compression with Null Symbol (CNS) Communication Protocol, Tri-digit Fibonacci Number System (TFNS) Communication Protocol **Security in Wireless Communication:** Introduction, Measures Against Attacks, Hardware Implementation of RC4 for One Byte per Clock

TEXTBOOKS:

1. Koushik Sinha, Sasthi C. Ghosh, Bhabani P. Sinha, “Wireless Networks and Mobile Computing”, CRC press, 1st edition 2015.

REFERENCEBOOKS:

1. Savo Glisic ,”Advanced Wireless Networks: Technology and Business Models”, Third Edition, John Wiley & Sons, Ltd, 2016.
2. Savo Glisic,”Advanced Wireless Networks: 4G Technologies”, John Wiley & Sons, 2006.
3. C. DeMorais and D. P. Agrawal, Ad hoc Networks – Theory and Applications, World Scentific Publishing, New Jersey (ISBN – 978-981-256-682-9).
4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks -Architectures and Protocols”, Prentice Hall, 2004.

JOURNALS/MAGAZINES

1. Kim, Taeyoung, et al. "Machine Learning for Advanced Wireless Sensor Networks: A Review." IEEE Sensors Journal (2020).
2. SINGH, UPINDERPAL, et al. "NEW: NEW EVOLUTION IN WIRELESS TECHNOLOGIES.", 2020.
3. Bin, M.A., Shangru, L.I. and Xianzhong, X.I.E., 2020. A Hierarchical Vertical Handover Algorithm Based on Fuzzy Logic in Heterogeneous Wireless Networks. *电子与信息学报*, *42*(3), pp.629-636.
4. https://ieeexplore.ieee.org/document/9116080

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/117/104/117104099/
2. https://www.coursera.org/learn/wireless-communications
3. https://www.coursera.org/learn/iot-wireless-cloud-computing
4. https://www.coursera.org/learn/network-security-communications-sscp

SELF-LEARNINGEXERCISES:

Explore Multi-input multi-output (MIMO) antenna systems

Develop skills to use Simulators for realizing wireless networks

Connectivity support in heterogenous wireless network

Explore network information theory.

Course Title	Compiler Design (PE-III)				Course Type		Theory	
Course Code	B20EJS609	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This Course intends to make students learn the techniques needed for compiler construction and also develops analytical skills. The course is conceptual.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the concepts of Object-Oriented programming, Object-Relational Databases and Compilers.
2. Describe how syntax tree can be constructed to check the syntax of the given input.
3. Discuss different types of parsers and syntax directed definition and translation.
4. Demonstrate how code optimization and code generation is done for a given source code.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the concepts of lexical, syntactic and semantic analysis to parse the given statement.	1,2,3,4,5,11,12	1
CO2	Experiment with the knowledge of different parsers by constructing the top down and SLR parsers.	1,2,3,4,5,11,12	2
CO3	Make use of different types of parsers and syntax directed definition and translation to check the syntax of the given input.	1,2,3,4,5,11,12	1
CO4	Develop code optimization and code generation for a given source code.	1,2,3,4,5,11,12	2,3
CO5	Learn new tools and technologies in the compiler designand apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldComputer Vision and Applications to the complex problems, either individually or as a part of the team	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1						2	2	3		
CO2	2	2	2	1	1						2	2		3	
CO3	2	2	2	1	1						2	2	3		
CO4	2	2	2	1	1						2	2		3	3
CO5												2		2	
CO6					3				2	2				2	

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1 **Introduction to Compilers:** Language processors; the structure of a Compiler; **Lexical analysis:** Tokens, Regular expressions, Finite state automata, translating regular expressions into finite state automata;
UNIT-2 **Syntax analysis 1:** Context-free grammars, Derivations and syntax trees, Handling ambiguous grammars, Top-down parsing, Bottom-up parsing – SLR( );

UNIT-3
Syntax Analysis 2: More powerful LR Parsers; **Syntax-directed translation:** Syntax-directed definitions; Evaluation orders for SDDs; Applications of syntax-directed translation; Parser stack implementation of Postfix SDT;
UNIT-4
Code optimization and generation: Basic blocks and Flow graphs; Optimization of basic blocks; **Intermediate code generation:** Variants of syntax trees; Three-address code; Control flow; back patching;

TEXT BOOKS:

1. A. V. Aho, R. Sethi and J. D. Ullman, Compilers – Principles, Techniques, and Tools, Addison-wesley, Pearson Education, 2001.
2. Charles N. Fischer, Richard J. leBlanc, Jr., Crafting a Compiler with C, Pearson Education, 1991.
3. Kenneth C Louden, Compiler Construction Principles & Practice, Cengage Learning, 1997.

REFERENCE BOOKS:

1. A.W. Appel, Modern Compiler Implementation in Java, Cambridge University Press, 2002.
2. IEEE, IEEE Transactions on Computers.
3. Elsevier, Computer Languages, Systems and Structures.
4. Springer, Journal of Logic, Language and Information.
5. ACM, ACM Transactions on Programming Languages and Systems (TOPLAS).

JOURNALS/MAGAZINES

1. https://www.springer.com/gp/book/9783319669656
2. https://ieeexplore.ieee.org/document/101813

SWAYAM/NPTEL/MOOCs:

6. https://nptel.ac.in/courses/106/104/106104123/
7. https://www.mooc-list.com/tags/compilers

SELF-LEARNINGEXERCISES:

More Recent Applications: translating regular expressions into finite state automata; survey of latest compilers for dealing with parallel programming.

Course Title	Advanced Topics in Machine Learning (PE-III)				Course Type		Theory	
Course Code	B20EKS610	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**-**	**50**	**50**

COURSE OVERVIEW

The course combines breadth and depth of concepts involved in machine learning, offering advanced concepts on learning, hypothesis, analytical learning, inductive analytical approaches to learning

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Enable students to understand advanced probabilistic concepts in machine learning
2. Explore various models in advanced machine learning.
3. Design model parameters
4. Help the student choose most appropriate model to solve a problem.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the advanced concepts in machine learning techniques	1,2,3,4,5,12	1,2
CO2	Examine the problem to determine correct model to apply	1,2,3,4,5,12	1,2
CO3	Estimate parameters of different types of models in advanced machine learning	1,2,3,4,5,12	1,2
CO4	Decide on the best ML approach and model to apply for solving a real world problem.	1,2,3,4,5,12	1,2
CO5	Learn new tools and technologies in the machine learning and apply for suitable application development.	12	2
CO6	Develop solutions in the related field machine learning to the complex problems, either individually or as a part of the team and report	5,9,10	2

BLOOM'S LEVELOF THECOURSE OUTCOME

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	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3			1	1			3	3	3	
CO2	3	3	3	3	3				1			3	3	3	
CO3	3	2	2	2	3				1			2	3	3	
CO4	3	3	2	3	3				1			3	3	3	
CO5												2		2	
CO6					3				2	2				2	

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1
Introduction – Machine Learning : what and why – Types of ML, Supervised Learning – Classification , Regression, Unsupervised Learning – discovering clusters, discovering latent factors. Parametric vs non-parametric models, a simple non-parametric classifier – K-nearest neighbors, Curse of dimensionality, Parametric models for classification and regression, linear regression, logistic regression, overfitting, model selection, no free lunch theorem. **A brief review of probability** – Discrete random variables, discrete distributions, Bayes rule. **Bayesian Statistics** - MAP estimation, Bayesian Occam's razor, Priors – Uninformative priors, Jeffreys priors, Robust priors, Mixtures of conjugate priors,

UNIT – 2

Gaussian Models : Introduction – notation, basics, MLE for an MVN, Maximum entropy derivation of the Gaussian, Linear discriminant analysis, two class LDS, Nearest shrunken centroids classifier

Linear Regression – Maximum Likelihood estimation least squares- derivation, robust linear regression, ridge regression – basic idea, connection with PCA, Bayesian Linear Regression – computing posterior, computing posterior predictive, Bayesian linear regression. **Bayesian Logistic Regression** – Laplace approximation.

UNIT – 3

Bayesian Concept Learning – Likelihood, prior, posterior, posterior predictive. Beta binomial model – likelihood, prior, posterior, posterior predictive, Dirichlet multinomial model-likelihood, prior, posterior, posterior predictive.

Gaussian Models – Notation, Basics, Maximum likelihood estimation for a MVN. Gaussian discriminant analysis – quadratic discriminant analysis, linear discriminant analysis, two class LDA, regularized LDA, nearest shrunken centroids classifier. **Advanced Models** -Generalized linear models – basics, Probit regression – ML/MAP estimation using gradient based optimization

UNIT – 4

Multi-task learning – Hierarchical Bayes for multi task learning, application to personalized email spam filtering, Directed Graphical Models (Bayes nets) – Markov and Hidden Markov Models, Medical Diagnosis, Mixture Models – Mixtures of Gaussians, using mixture models for clustering. EM algorithm for GMMS, l1 and l2 regularization, Kernel functions – RBF, kernels for comparing documents, Mercer kernels, linear kernels, Matern kernels, string kernels, string kernels, Pyramid match kernels. Kernel machines, kernel trick, kernelized nearest neighbor classification, kernelized K-medoids clustering, kernelized ridge regression.

TEXTBOOKS:

1. Kevin P. Murphy Machine Learning: A Probabilistic Perspective,2012, The MIT Press.

REFERENCEBOOKS:

1. Tom M. Mitchell, “Machine Learning”, India Edition McGraw Hill Education,2013.
2. Chris Bishop,“Pattern Recognition and Machine Learning” , Springer (India) Private Limited, 2013.
3. Ethem Alpaydin, “Introduction to Machine Learning”, Second edition MIT press, 2010, Chapters 1, 2, 6, 7, 19.
4. Yoshua Bengio and Aaron Courville ,”Deep Learning”,Ian Good fellow, MIT Press book,2016.
5. Richard o. Duda, Peter E. Hart and David G. Stork, “Pattern classification”, John Wiley & Sons Inc., 2001

JOURNALS/MAGAZINES

1. IEEE Transactions on Pattern Analysis and Machine Intelligence
2. Springer machine learning
3. Elsevier Computational Statistics and Data Analysis
4. Wiley- International Journal of Intelligent Systems

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/106/106106198/

2. Advanced Machine Learning Specialization -Coursera

SELF-LEARNINGEXERCISES:

Latent linear models – factor analysis, PCA, Sparse linear models,

Course Title	Advanced Computer Architecture (PE-III)				Course Type		Theory	
Course Code	B20EKS611	Credits	3		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

The objective of this course is to make students learn advanced computer architecture. The students learns the different aspects of pipe lining, parallelism using instruction level and data parallelism

COURSE OBJECTIVE (S):

Objectives of this course are to:

5. Explain the fundamentals of quantitative design,analysis and memory design
6. Describe instruction level parallelism and know about ILP
7. Define the different aspects of data parallelism
8. Illustrate the techniques for thread level parallelism
9. Provide a continues learning on design and evolution of chips and computer architecture under optimizations
10. Describe the vision of architectural enhancements and research challenges.

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 quantitative, analysis and memory design.	1,2,3,4,5	1
CO2	Make use of different techniques of instruction level parallelism for real world application.	1,2,3,4,5	1
CO3	Identify the different data parallelism technique for given instruction.	1,2,3,4,5	1
CO4	Apply thread level parallelism in programming effectively.	1,2,3,4,5	2
CO5	Provide an understanding in evaluating architecture development and familycategorization.	3,4,6,11,12	2,3
CO6	Continues Learning objectives with evolving computer architecture design and optimization towards research gaps and challenges	4,5,11	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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	2								3		
CO2	3	2	3	3	3								3		
CO3	3	3	2	2	2								3		
CO4	3	3	2	3	2									2	
CO5			3	2		3					2	2		1	3
CO6				3	3						3				2

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Fundamentals of Quantitative Design and Analysis: Introduction, Classes of Computers, Defining Computer Architecture, Trends in Technology, Trends in Power and Energy in Integrated Circuits, Trends in Cost, Dependability, Measuring, Reporting, and Summarizing Performance, Quantitative Principles of Computer Design, Putting It All Together: Performance, Price, and Power **Memory Hierarchy Design:** Introduction, Ten Advanced Optimizations of Cache Performance, Memory Technology and Optimizations, Protection: Virtual Memory and Virtual Machines, Crosscutting Issues: The Design of Memory Hierarchies, Putting It All Together
UNIT-2
Instruction-Level Parallelism: Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Overcoming Data Hazards with Dynamic Scheduling, Dynamic Scheduling: Examples and the Algorithm, Hardware-Based Speculation, Exploiting ILP Using Multiple Issue and Static Scheduling, Exploiting ILP Using Dynamic Scheduling, Multiple Issue, and Speculation, Advanced Techniques for Instruction Delivery and Speculation, Studies of the Limitations of ILP, Cross-Cutting Issues: ILP Approaches and the Memory System, Multithreading: Exploiting Thread-Level Parallelism to Improve Uniprocessor Throughput, Putting It All Together: The Intel Core i7 and ARM Cortex-A8
UNIT-3
Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop-Level Parallelism, Crosscutting Issues, Putting It All Together: Mobile versus Server GPUs and Tesla versus Core i7
UNIT-4
Introduction, Centralized Shared-Memory Architectures, Performance of Symmetric Shared-Memory Multiprocessors, Distributed Shared-Memory and Directory-Based Coherence, Synchronization: The Basics, Models of Memory Consistency: An Introduction, Crosscutting Issues, Putting It All Together: Multicore Processors and Their Performance

TEXT BOOKS:

1. John Hennessy David Patterson, Morgan Kaufmann, Computer Architecture, 5th Edition, A Quantitative Approach, September 2011

2. Kai Hwang, Naresh Jotwan, Advanced Computer Architecture, 3e, Tata McGraw Hill.

3. Dezso Sima, Advanced Computer Architectures: A Design Space Approach,.

REFERENCE BOOKS:

1. Chopra Rajiv, Advanced Computer Architecture, A Practical App.

2. Nicholas Carter , Raj Kamal, Computer Architecture and Organisation: Schaum's Outlines Series.

JOURNALS/MAGAZINES

5. https://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=10208
6. https://www.springer.com/gp/book/97898115813

SWAYAM/NPTEL/MOOCs:

3. https://onlinecourses.nptel.ac.in/noc19_cs62/preview
4. https://www.classcentral.com/course/swayam-advanced-computer-architecture-13884

SELF-LEARNINGEXERCISES:

The concepts of pipelining and the effects of pipelining in programming. The harzards of pipelining is also important topics.

Course Title	Embedded Systems (PE-III)				Course Type		Theory	
Course Code	B20EKS612	Credits	3		Class		VI Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	0	0	0	Theory	Practical	CIE	SEE
	-	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces different learning approach for embedded systems. It looks at embedded system as a whole, specifies what it is, what it comprises of what is to be done with it, and how to go about the whole process of designing an embedded system with processor, sensors, memory and I/O. It also focusses on hardware/software codesign, real time operating system concept in realizing embedded system and embedded system development environment with an extension to introducing current trends in industry. Enough care is taken to provide in-depth knowledge in embedded system with a facility to build projects, case studies, etc.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Discuss brief idea about the embedded system components, memory, communication interfaces and other firmware components.
2. Understand the Quality attributes, hardware and Software co-design, Computational models in embedded systems, Unified Modelling languages etc.
3. Understand the firmware system development and firmware development languages.
4. Explore the fundamentals of RTOS, Integrated Development Environment, Simulators and Emulators.
5. Explain trends in embedded system development.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Interpret various hardware and software components of embedded system	1, 2, 3, 4	2
CO2	Understand the quality attributes, hardware-software co-design in embedded systems.	1, 3, 4	3
CO3	Apply RTOS concepts for embedded system design	2, 3, 4, 5, 6	2
CO4	Evaluate IDE for embedded system and interpret emulator, hardware debugging and boundary scan concepts	4, 5, 6,11	3
CO5	Provide a continues learning approach for analysing embedded system applications and operation standards	5,6,11	2,3
CO6	Validating and understanding the change of technological aspects of embedded system applications and configurationinfrastructure	5,7,11,12	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#/	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3										3	

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT – 1 **Introduction to Typical Embedded System:** Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components
UNIT – 2 **Characteristics and Quality Attributes of Embedded Systems** Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language **(Self Study/Case Study)**, Hardware Software Trade-offs **Embedded Firmware Design and Development:** Embedded Firmware Design Approaches, Embedded Firmware Development Languages
UNIT – 3 **Real-Time Operating System (RTOS) based Embedded System Design:** Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronization, Device Drivers, How to Choose an RTOS **(Self Study/Case Study)**
UNIT – 4 **The Embedded System Development Environment:** The Integrated Development Environment (IDE) **(Self Study/Case Study)**, Types of Files Generated on Cross-compilation, Disassembler/Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan. **Trends in the Embedded Industry**:**(Self Study/Case Study)**, Processor Trends in Embedded Systems, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks

TEXTBOOKS:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2009
2. James K Peckol , "Embedded Systems – A contemporary Design Tool", John Wiely, 2008.

REFERENCEBOOKS:

1. Wayne Wolf, — Computers as Components, Principles of Embedded Computing Systems Design‖, Elsevier, 2 nd Edition, 2009.
2. Dr. K. V. K. K. Prasad, — Embedded / Real-Time Systems: Concepts, Design & Programming‖, dreamtech publishers, 1 st Edition, 2003.
3. Frank Vahid, Tony Givargis, —Embedded System Design‖, John Wiley & Sons, 3 rd Edition, 2006.
4. Lyla B Das, —Embedded Systems‖ , Pearson Education, 1 st Edition, 2012.
5. David E. Simon, —An Embedded Software Primer‖, Addison-Wesley, 1 st Edition, 1999.
6. Michael J. Pont, —Embedded C‖, Pearson Education, 2nd Edition, 2008.

JOURNALS/MAGAZINES

1. https://www.inderscience.com/jhome.php?jcode=ijes
1. http://www.sciencepublishinggroup.com/journal/index?journalid=236
2. https://www.electronicsweekly.com/market-sectors/embedded-systems/
3. https://www.embedded.com/embedded-systems-design-magazine-archive/
4. https://spectrum.ieee.org/computing/embedded-systems

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/mastering-microcontroller-with-peripheral-driver-development/
2. https://www.coursera.org/learn/embedded-software-hardware
3. https://www.coursera.org/specializations/embedded-systems-security
4. https://www.coursera.org/specializations/embedded-systems-security
5. https://nptel.ac.in/courses/108/102/108102045/

Self-LearningExercises/Case Study:

1. Explore various hardware embedded system designs
2. Build projects using IoT and hardware to illustrate embedded system concepts
3. Design complex automation system using embedded programming
4. Create real time application using ARM processor

Course Title	Data Mining (OE-II)				Course Type		Theory	
Course Code	B20CI0601	Credits	3		Class		VIsemester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Data mining is a major area of exploration for knowledge discovery in databases. Data mining is for relatively unstructured data for which more sophisticated techniques are needed. The course aims to cover powerful data mining techniques including clustering, classification and association rules.

COURSE OBJECTIVE (S):

1. Introduce the basics of data mining, data types, similarity and dissimilarity measures
2. Explain association rules and algorithms
3. Describe the classification algorithms for data categorization
4. Illustrate the clustering algorithms for grouping datasets
5. Demonstrate the appropriate data mining techniques for decision-making

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Explain the basics of data mining techniques, data types, identify the similarity and dissimilarity between the datasets and analyze the data sets using the association rules andalgorithms	1,2,4,6,11,12	1,2
CO2	Characterize and discriminate data sets with classificationmethods	1,2,3,4,5,6,7	2
CO3	Employ the clustering methods in real lifeproblems	1,2,3,4,5,6,7	2,3
CO4	Apply the knowledge for data miningapplications	1,2,3,4,5,6,7, 12	2,3
CO5	Learn new tools and technologies in the data miningand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the data mining to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation	5,9,10	1,2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		1		1					2	1	2	3	
CO2	3	3	2	2	3	2	1						3	3	
CO3	3	2	3	2	3	2	3							3	3
CO4	3	2	3	2	3	1	1					2		3	3
CO5	3		3									2		3	
CO6	3		3											3	

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

COURSE CONTENT

THEORY

UNIT-1
Introduction: What is Data Mining? Motivating Challenges, The origins of data mining, Data Mining Tasks, Types of Data, Data Quality, Data Preprocessing, Measures of Similarity and Dissimilarity, Data Mining Applications, Visualization.
UNIT-2
Association Analysis: Basic Concepts and Algorithms, Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, Alternative methods for generating Frequent Itemsets, FP GROWTH Algorithm, Evaluation of Association Patterns .
UNIT-3
Classification: Basics, General approach to solve classification problem, Decision Trees, Evaluating the performance of a Classifier, Rule Based Classifiers, Nearest Neighbour Classifiers, Naïve Bayes Classifier
UNIT-4
Clustering: overview, K-means**,** agglomerative hierarchical clustering, DBSCAN, Cluster Evaluation, Characteristics of Data, Clusters and Clustering Algorithms, Prototype Based Clustering.

TEXTBOOKS:

1. A Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson Education,2007.
2. JiaweiHanandMichelineKamber,"DataMiningConceptsandTechniques"SecondEdition,Elsevier, Reprinted2008.

REFERENCE BOOKS:

1. K.P.Soman,ShyamDiwakarandV.Ajay,"InsightintoDataminingTheoryandPractice",Easter Economy Edition, Prentice Hall of India,2006.
2. G.K.Gupta,"IntroductiontoDataMiningwithCaseStudies",EasterEconomyEdition,Prentice Hall of India,2006.

JOURNALS/MAGAZINES:

1. Data Mining and Knowledge Science – Springer.
2. Interscience,The International Journal of DataMining, Modelling and Management-
3. IEEE, IEEE Transactions on Knowledge and Data Engineering.

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. Introduction to Data Mining- Coursera
3. Data Mining Specialization- Coursera

SELF- LEARNING EXERCISES:

Decision Trees, Rule Based Classifiers, Nearest Neighbour Classifiers

Course Title	MACHINE LEARNING (OE-II)				Course Type		Theory	
Course Code	**B20CI0602**	**Credits**	**3**		**Class**		**VIsemester**	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can process through large volumes of data at high speed to make predictions or decisions without human intervention.

COURSE OBJECTIVES (S):

The objectives of this course are to:

1. Explain machine learning and problems relevant to machine learning.
2. Discuss the fundamentals of Decision trees learning and its issues
3. Illustrate neural networks, Bayes classifier and k nearest neighbour for problems appearing in machine learning.
4. Describe statistical analysis of machine learning techniques.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Design the learning system to provide the solution for the given problem.	1,2,3,4,5	1, 2, 3
CO2	Apply Decision Tree technique for Classification problem	1,2,3,4,5	1, 2, 3
CO3	Develop Recognition or Prediction systems using Neural Network/Bayesian Model	1,2,3,4,5	1, 2, 3
CO4	Solve the problem by hypothesis testing using probability and statistics.	1,2,3,4,5	1, 2, 3
CO5	Learn new tools and technologies in the machine learningand apply for suitable application development.	12	1, 2
CO6	Develop solutions in the machine learning to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2								3	3	3
CO2	2	2	2	3	2								3	3	3
CO3	2	3	2	2	2								3	3	3
CO4	3	2	2	2	2								3	3	3
CO5	3	2	2		2								3		3
CO6	3		2		2								3	3	

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

COURSE CONTENT:

THEORY

UNIT-1
Introduction: Well posed learning problems, designing a Learning system, Perspective and Issues in Machine Learning. Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.
UNIT-2

Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.
UNIT-3
Artificial NeuralNetworks: Introduction,NeuralNetworkrepresentation, appropriate problems, Perceptrons, Back propagation algorithm. **Bayesian Learning**: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.
UNIT-4
Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. **Instance Based Learning**: Introduction, k-nearest neighbour learning, locally weighted regression, radial basis function, cased-based reasoning.

TEXTBOOKS:

1. Tom M. Mitchell, Machine Learning, India Edition McGraw Hill Education,2013.

REFERENCEBOOKS:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, 2nd edition, springer series in statistics.
2. EthemAlpaydın, “Introduction to machine learning”, second edition, MIT press.

JOURNALS/MAGAZINES:

1. Journal of Machine Learning Research,https://www.jmlr.org/
2. https://ieeexplore.ieee.org/document/8070809
3. https://www.ieeesmc.org/technical-activities/cybernetics/machine-learning
4. https://www.engpaper.com/machine-learning-ieee-papers-2019.htm

SWAYAM/NPTEL/MOOCS:

1. https://nptel.ac.in/courses/106/106/106106139/
2. Introduction to Machine Learning, Machine Learning, Deep Learning-Cousera

SELF-LEARNING EXERCISES:

Reinforcement Learning: Introduction, Learning Task, Q Learning

Course Title	Neural Network (OE-II)				Course Type		Theory	
Course Code	B20CIO603	Credits	3		Class		V semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 week / Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course introduces the basic learning models, learning algorithms, and some applications of neural networks. The focus is on to understand and use neural networks for solving different problems related to pattern recognition, function approximation, data visualization, etc.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Understand mathematical basics of neural networks.
2. Choose appropriate error function and optimization algorithm
3. Enable a student to train a neural network using suitable approach
4. Design real world solutions using Neural networks.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Outline the mathematical concepts behind working of neural networks.	1,2,3,4,5	1
CO2	Illustrate the error functions and optimization algorithms that can be applied to a neural network model	1,2,3,4,5	2
CO3	Demonstrate the training of a neural network model to solve a problem.	1,2,3,4,5	3
CO4	Design a neural network using Tensor Flow to solve a real world problem.	1,2,3,4,5	3
CO5	Learn new tools and technologies in the neural networksand apply for suitable application development.	12	1, 2

CO6	Develop solutions in the neural networks to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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

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

COURSE CONTENT:

THEORY

UNIT-1
Neural Network Basics – Statistical Pattern Recognition – an example character recognition, classification and regression, pre-processing and feature extractions, polynomial curve fitting, multivariate non-linear functions, decision boundaries, minimizing risk, single layer networks – linear discriminant functions, linear separability, least squares techniques, the perceptron, multi-layer perceptron – feed forward network mappings, threshold units, sigmoidal units, error back propagation, Jacobian Matric, Hessian matrix.
UNIT-2
Learning and Generalization: Error Functions and Parameter Optimization Algorithms –Sum of squares error, Minkowski error, input dependent variance, modelling conditional distributions, estimating posterior probabilities, sum of squares for classification, cross entropy for two classes, entropy. Error Surfaces, Local quadratic approximation, linear output units, optimization in practice, gradient descent, conjugate gradients, Newton's Method, Bias and Variance, Regularization, Training with noise, soft weight sharing, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, Softmax Output Layers, Looking Forward
UNIT-3.
Training Feed-Forward Neural Networks: The Fast-Food Problem, Gradient Descent, The Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, The Back-propagation Algorithm, Stochastic and Mini batch Gradient Descent, Test Sets, Validation Sets, and Over fitting, Preventing Over fitting in Deep Neural Networks. Back Propagation: The Back propagation Network, The Generalized Delta Rule, Practical Considerations, BPNApplications, The Back propagation Simulator.
UNIT-4
Implementing Neural Networks in Tensor Flow: Definition of Tensor Flow, Installing Tensor Flow, Creating and Manipulating Tensor Flow Variables, Tensor Flow Operations, Placeholder Tensors ,Sessions in Tensor Flow, Navigating Variable Scopes and Sharing Variables, Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in Tensor Flow, Logging and Training the Logistic Regression Model, Leveraging Tensor Board to Visualize Computation Graphs and Learning, Building a Multilayer Model for MNIST in Tensor Flow.

TEXT BOOKS:

1. Christopher M Bishop, "Neural Networks for Pattern Recognition", Clarendon Press, Oxford, 2005.
2. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning, designing next-generationmachine intelligence algorithms", O'Reilly, 1st Edition.

REFERENCE BOOKS:

1. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2003.
2. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TATA Mc Graw Hill, 2006

3. Neural Networks Algorithms, Applications, and Programming Techniques - James A. Freeman

JOURNALS/MAGAZINES

1. IEEE Transactions on Neural Networks and learning systems
2. IEEE Transactions on Evolutionary Computation
3. IEEE Transactions on Fuzzy systems
4. Journal of Applied Soft Computing –Elsevier

SWAYAM/NPTEL/MOOCs:

1. www.cs.stir.ac.uk/courses/ITNP4B/lectures/kms/1-Intro.pdf
2. https://www.nptel.ac.in/courses/106/106/106106184

SELF-LEARNING EXERCISES:

Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall

Algorithm, Stability Analysis. Neural network applications: Process identification, control, fault diagnosis.

Course Title	Research Based Mini Project				Course Type		Theory	
Course Code	B20EK0604	Credits	2		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13 weeks / Semester		Assessment in Weightage	
	Theory	-	-	-				
	Practice	2	4	4				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**2**	**4**	**4**	**0**	**52**	**50**	**50**

COURSE OVERVIEW

This course offers "An overview of research methodology including basic concepts employed in quantitative and qualitative research methods. This course introduces problem selection, synopsis writing, ethics, research design skills, research methods, how to carry out literature survey, reading and writing technical paper, thesis writing, introduction latex and beamer and how to design the quality research proposal.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the dimensions and methods of research.
2. Illustrate the design of informed choice from the large number of alternative methods and experimental designs available.
3. Describe the features of a good research proposal.
4. Discuss the skills required for undertaking a research project and preparing a technical paper.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the dimensions and methods of research for solving real world problems.	1,4,7,11,12	2,3
CO2	Identify the appropriate research problem and parameters to carry out the research work.	2,5,6,12	2,3
CO3	Apply different research skills in preparing proposal for research project and technical paper.	6,7,11	2,3
CO4	Create IPR documents using Latex Tool.	3,12	3
CO5	Learn new tools and technologies in the research based mini project and apply for suitable application development.	12	1, 2
CO6	Develop solutions in the research based mini project to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2			2			1				1	1		3	3
CO2		2			1	3						2		3	3
CO3						2	1				2			3	3
CO4			2									2			3
CO5			2		1							2			3
CO6		2		2								2			3

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

A Mini Project has to be carried out by the students and the same has to be completed by the end of semester. Students have to spend a minimum of 8 hours per week on the mini project. A Mini Project has to be developed and documented using Latex. The outcome of the mini project should be paper publication/ IPR

Course Title	Indian Tradition and Culture				Course Type		Theory	
Course Code	B20PA0501	Credits	2		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	2	2	2				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**2**	**2**	**2**	**26**	**0**	**50**	**50**

COURSE OVERVIEW

This course offers the students with various aspects of culture and heritage of India..This course also enable the students to understand the contribution of our ancestors in the areas of science,medicine,arts,language and literature

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. To provide conceptual knowledge of Indian culture and traditions
2. To introduce students to the science and technological advancements related to Indian culture
3. To help students understand the Indian spiritual aspects of Indian culture
4. To help learners understand the factors which unite the diverse cultures of India

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Gain conceptual understanding of Indian culture and traditions.	2,3,4,6,8,12	3
CO2	Describe various ancient theories in treatment of any disease, Appreciate the science and technological advancements in ancient India.	10.,11	3
CO3	Comprehend the Indian spiritual aspects of Indian culture like yoga, meditation and nirvana.	11	3
CO4	Demonstrate the theory behind celebrating Hindu festivals and concept of making varieties of food and Understand India as a land united by cultural diversity	11,12	3
CO5	Learn new tools and technologies in the indian tradition and culture and aply for suitable application development.	12	1, 2
CO6	Develop solutions in the indian tradition and culture to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	1,2

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

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

COURSE CONTENT

THEORY

UNIT-1

Indian Tradition Culture – Indus Valley Civilization and early cultural practices, The Vedic culture, Influence of Buddhism and Jainism on Indian Culture, Influence of Islam and Christianity, Indian Cultural Renaissance of the 19th Century

Religion – Pre-vedic and Vedic religion, Jainism, Buddhism, Hinduism, Religious Reform Movements, Advent of Christianity

Art – Introduction to Natyashastra, classical and contemporary art forms (dance and music), regional art forms (dance and music), Folk art, puppetry

Architecture – Engineering and Architecture in Ancient India; Evolution of Hindu Temple Structures, Sculptures, Coins and Pottery from Ancient India

Literature- Vedas, Upanishads, Ramayana, Mahabharata &Bhagavat Gita.

UNIT-2

Contribution of ancient India to Science and Maths . Development of Science in Ancient India- Astronomy, Mathematics, Medicine, Metallurgy.Scientists of Ancient India: Mathematics and Astronomy- Baudhayan, Aryabhata, Brahmagupta, Bhaskaracharya, Mahaviracharya Science- Kanad, Varahamihira, Nagarjuna Medical Sciences (Ayurveda and Yoga)- Susruta, Charaka, Yoga and PatanjaliScience and Scientists in Medieval India- Mathematics, Biology, Chemistry, Astronomy, Medicine, Agriculture. Scientists in Modern India- Srinivas Ramanujan, Chandrasekhara V Raman, Jagadish Chandra Bose, HomiJehangirBhabha, Dr, Vikram Ambalal Sarabhai, ,Dr. APJ Abdul Kalam

UNIT-3

Indian Spiritual Aspects Hindu Spirituality based on shruti and smriti- Hinduism in General, Basic notions of Vedas, Upanishads, Ramayana, Mahabharata &Bhagavat Gita.

Hata Yoga and Pranayama- Main Features, Basics of Yoga –Different kinds of Yoga; Raja Yoga (Ashtanga yoga); Karma yoga; Bhakti Yoga – yoga of Loving Devotion; Jnana yoga – Yoga of Knowledge; Hatha Yoga (Asana/ Pranayamas); Kundalini Yoga; Nada Yoga; Sannyasa Yoga

Buddhist, JainaSpiritualities- Main Doctrines of Buddhism: Four Noble Truths (Arya Satya), Concept of Nirvana - AshtangaMarga

UNIT-4

Unity in Diversity Commensality and the Significance of Food – Eating Together as Family and as a Society, Food at Rituals; annaprasan, marriage and funeral, Kitchen as Shared Space for Women, Food and Nationalist Response of Indian Community, Visibility of Indian Cuisine in the World

Celebrating Diverse Festivals – Festival Types: Religious and Seasonal, Religious - Holi, Diwali, Ganesh Chaturthi, Janmashtami, MahavirJayanthi, Ramadan, Christmas, Buddha Purnima; Seasonal (harvest festivals) - Baisakhi, Pongal, Sankranti

Attire - Indus Valley Civilization, Vedic period, Modern India

TEXT BOOKS:

1. Sundararajan K.R., Hindu Spirituality - Vedas through Vedanta, Cross Road Publications, New York, 1997.

2. Griffiths Bede, Yoga and the Jesus Prayer Tradition, Asian Trading Corporation, Bangalore, 1992

3. Ansh Mishra, Science in Ancient India, Indian Corporation, New Delhi, 1998

4. Sen Taylor, Collen. Feasts and Fasts: A History of Food in India. Reaktion Books, New Delhi, 2014.

5. Thapar, Romila, Readings in Early Indian History. Oxford University Press. New Delhi, 2018

JOURNALS/MAGAZINES

1. https://www.jstor.org/stable/538560?seq=1
2. https://www.livescience.com/28634-indian-culture.html

3. https://www.inderscience.com/info/ingeneral/forthcoming.php?jcode=ijicbm

SWAYAM/NPTEL/MOOCs

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/109/103/109103018/

SELF-LEARNING EXERCISES:

Indian Painting Tradition, Evolution of script and languages in India

Course Title	Brain Machine Interface				Course Type		Theory	
Course Code	B20EA0602	Credits	2		Class		VI semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	1	1	1				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**2**	**3**	**3**	**13**	**26**	**50**	**50**

COURSE OVERVIEW

Brain Machine interface (BMI) technology provides a means of communication that allows individuals with severely impaired movement to communicate with assistive devices using the electroencephalogram (EEG) or other brain signals. The practicality of a BMI has been possible due to advances in multi-disciplinary areas of research related to cognitive neuroscience, brain-imaging techniques and human-computer interfaces.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Gain knowledge on different types of BMI signals from instruments.
2. Gain knowledge on the major components of BMI which makes up the system.
3. Gain expertise on Brain machine interfacing.
4. Discuss BMI applications and strategies.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POS	PSOs
1	Describe different types of BMI signals from instruments	1	1,2
2	Describe different types of brain signals used for feature extraction	1,2	1,2
3	Discuss the major components of BMI which makes up the system	1,5, 12	1,2
4	Explain the applications based on BMI	1,5, 12	1,2
5	Use the toolbox BMILAB	1,5,9, 12	1,2
6	Develop solutions in the brain machine interface to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	1,5,9,12	1,2

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

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

COURSE CONTENT

THEORY

UNIT-1

Brain computer interface: What is BCI? How do BCI works, Brain computer interface types-Invasive, Partially invasive, Non-invasive, Brain signal for BCI signal-EEG, MEG, fNIRS, fMRI , Non brain signals for BCI

UNIT-2

Interfacing Brain and Machine: Introduction, The Brain and Electrode Placement, Operational Techniques in BCI, Data Acquisition, Pre-processing: A Signal Enhancement Requirement along with Noise Reduction, Feature Extraction, Classification, Post-processing, Validation and Optimization Techniques, Graphical User Interface [GUI], Strategies in BCI Applications, Performance Measures of a BCI System.

UNIT-3

Data Acquisition, Pre-processing: A Signal Enhancement Requirement along with Noise Reduction, Feature Extraction,
UNIT-4 Classification, Post-processing, Validation and Optimization Techniques, Graphical User Interface [GUI], Strategies in BCI Applications, Performance Measures of a BCI System.

Practise:

No.	Title of the Experiment	Tools and Techniques	Expected Skill /Ability
1.	Introduction to EEG	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Set up EEG hardware and experiment • Record from the first subject; recognize good electrode impedance and noisy vs. high-quality data • Learn the basics of Simulink
2.	Biological Artifacts in EEG	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Begin analyzing data in MATLAB • Implement FIR filtering to reduce the effects of biological and nonbiological artifacts on the data • Learn about different neural oscillations and associated cognitive processes
3.	Neurofeedback	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Create a real-time measure of alpha and theta powers in Simulink • Understand mechanisms of neurofeedback
4	P300 Speller	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce the concept of event related potentials and describe various ERP components • Apply a preprogrammed module to record data and to control a brain-controlled on-line speller • Find ERPs to target vs. non-target letters and mark the significant P300 responses

5	Auditory ERP	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce auditory ERP components and the auditory oddball paradigm • Design an event marker to track experimental events • Plot neural response on a scalp map; find spatial location of ERP components
6.	Auditory Steady State Response	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce ASSR and frequency-modulated neural components • Design and program an ASSR experiment • Analyze data in the frequency domain using the fast Fourier transform (FFT)
7	Attentional Modulation of ASSR	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Investigate the effect of attention on ASSR paradigm • Implement online analysis in real-time using Simulink
8	Steady State Visually Evoked Potentials	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Introduce SSVEP and its applications • Analyze data in frequency domain in a visual paradigm
9	Imagined Movement	• Hardware setup • MATLAB and Simulink • EEG recording and analysis software	• Understand the basics of human motor cortex • Apply a preprogrammed module to record data for further processes
	Mini Projects i. Auditory Oddball Paradigm		• Design and program an auditory oddball experiment • Investigate the effect of subject attention and deviant probability on different ERP components • Implement group analysis using shared dataset between groups

	ii. Decoding Imagined Movement		• Calculate common spatial pattern (CSP) filters and project data into CSP space • Train an LDA classifier to decode imagined movement of single trials using CSP • Test classifier with cross-validation

- Design of Robotic Wheelchair Through Brain-Machine Interface
- A Feasibility Study for Developing an Emotional Control System Through BMI
- On board Chess playing using Brain Machine Interface
- Analysis on the effect of Colors on Human emotions and Blood groups using BMI
- Brain Browser using BMI – An application for physically challenged
- A study on the effect of Yoga and Meditation on Human physical system using BMI.
- Learning-enhancer: Optimizing studying habits with BCI. An EEG based software, which learns the user's learning behavior. After a few learning sessions, the software will be able to: 1. Tell the user at what times she is at her peak performance, for better learning session planning, and 2. Tell the user at real time when she should stop learning and rest for a few minutes, to work better afterwards.
- Stay-awake app: Are you falling asleep when you should actually be awake??? (i.e., while driving, in a boring conference meeting, while studying). Develop an application which will monitor your brainwaves, and when it detects that you're falling asleep- will provide real time feedback via earphones or loudspeaker (i.e., loud noise, rhythmic music) to wake you up immediately!!!
- Turner: Aim to reduce bicycle traffic accidents using the power of the mind. Using a headband integrated into a bicycle helmet, we will predict the rider's intention to perform maneuvers- turn left or right- and alert the surrounding traffic by blinking lights in the respective direction. Like a car's turn signal.
- EEG Rubik's Cube: Build a device that will manipulate a Rubik cube using EEG input. Depending on our helmet's capabilities, the control of the device will be more interesting. The basic scenario: The Rubik Cube will be solved only when you are really concentrating at something.

TEXTBOOK:

1. "Brain Computer Interfacing an Introduction", Rajesh P N Rao, Cambridge University Press, 2013, 9780521769419.
2. "Brain-Computer Interfacing for Assistive Robotics", Valbhav Gandhi, Academic Press, 2014. eBook ISBN: 9780128015872.

REFERENCEBOOKS:

1. Brain-Computer Interfaces: Lab Experiments to Real-World Applications, Damien Coyle, 2016, ISBN: 9780128092620.

SWAYAM/NPTEL/MOOCs:

1. https://www.udemy.com/course/brain-computer-interface/

SELF-LEARNINGEXERCISES:

Color Meditation – Effect of Blue color on Human thought and its side effects
Design of an EEG based Emotion Recognition System –An Application to Music Thera

Detailed Syllabus

Semester-7

Title	Swarm and Bio-Inspired Intelligence (PE-V)				Course Type		Theory	
Course Code	B20EAS701	Credits	3		Class		VII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

The basics of swarm and bio inspired intelligence are introduced. The course also provides knowledge Bio-inspired algorithms such as ant colony algorithm, bat algorithm (BA), cuckoo search (CS), firefly algorithm (FA), and particle swarm optimization.

COURSE OBJECTIVE(S):

The objectives of this course are to:

1. Impart the knowledge of swarm and bio inspired intelligence
2. Illustrate the swarm intelligence algorithms
3. Discuss metaheuristic Algorithms
4. Analyze Swarm algorithms

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the fundamentals of Swarm and Bio inspired intelligence	1,2,4,5	1,2
CO2	Analyze the performance of Swarm based Algorithm for Constrained Optimization	1,2,3,4,5	1,2
CO3	Apply Meta heuristic algorithm for Metaheuristic Optimization	1,2,3,4,5	1,2
CO4	Develop a program to solve real world problem using Self-Adaptive Memantic Swarm Optimization Algorithm.	1,2,3,4,5	1,2
CO5	Learn new tools and technologies in the **swarm** and bio-inspired intelligence and apply for suitable application development.	12	2
CO6	Develop solutions in the related field swarm and bio-inspired intelligence to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	2

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

CO#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		2	1								3	3	
CO2	3	2	2	1	1								3	3	
CO3	3	2	2	1	1								3	3	
CO4	3	2	1	1	1								3	3	
CO5												2		2	
CO6					3				2	2				2	

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

COURSE CONTENT

THEORY:

CONTENTS
Unit-1
Introduction to swarm and bio inspired Intelligence. Current Issues in Bio-Inspired Computing, Search for the Magic Formulas for Optimization, Characteristics of Metaheuristics, Swarm-Intelligence-Based Algorithms
Unit-2
Analysis of Swarm Intelligence Based Algorithms for Constrained Optimization, Ant bee colony, Cuckoo search, Numerical examples
Unit-3
Metaheuristic Algorithms, Le´vy Flights in Global Optimization, Metaheuristic Algorithms Based on Le´vy Probability Distribution: Is It a Good Idea?
Unit-4
Memetic Self-Adaptive Firefly Algorithm, Swarm Algorithms

TEXT BOOKS:

1. Xin-She Yang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet Karamanoglu,"Swarm Intelligence and Bio Inspired Computation", Elsevier, 1st Edition, 2013.
2. Eric Bonabeau, Marco Dorigo, Guy Theraulaz "Swarm Intelligence: From Natural to Artificial Systems", Springer, 19
3. Felix Chan, Manoj Tiwari, "Swarm Intelligence: Focus on Ant and Particle Swarm Optimization", InTech, 2007
4. Veysel Gazi and Kevin M. Passino, "Swarm Stability and Optimization", Springer, 2011

REFERENCE BOOKS:

1. James Kennedy and Russel Eberhart, "Swarm Intelligence", Morgan Kaufmann, 2001.
2. Zbigniew Michalewicz and David Fogel, "How to solve it: Modern Heuristics", Springer, 2001.
3. Marco Dorigo and Thomas Stützle, "Ant Colony Optimization", The MIT Press, 2004.
4. C. Solnon, "Ant Colony Optimization and Constraint Programming", Wiley 2010.
5. Gerhard Weiss, "Multiagent Systems: A modern approach to distributed artificial systems", The MIT Press, 2000.
6. Christian Müller-Schloer, Hartmut Schmeck and Theo Ungerer, "Organic Computing — A Paradigm Shift for Complex Systems", Springer, 2011.

JOURNALS/MAGAZINES

1. https://www.springernature.com/gp/researchers/text-and-data-mining
2. https://www.researchgate.net/publication/220834557_Using_Swarm_Intelligence_Techniques_in_Document_Management_Syste

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ma29/
2. Bioinspiration-Coursera

SELF-LEARNINGEXERCISES:

Comparative study of swarm and bio inspired algorithms

Course Title	Augmented and Virtual Reality (PE-III)				Course Type		Theory	
Course Code	B20EKS702	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	3	3	3	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

This course covers basic concepts of augmented reality and virtual reality. The course also introduces the student to the working of multiple models of input and output interface in VR. The course also helps the student to understand development tools and frameworks in VR. Further, this course helps the student to work on the application of VR in digital entertainment.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the principles and multidisciplinary features of Virtual Reality.
2. Illustrate the multimodal user interaction and perception in Virtual Reality.
3. Demonstrate the use of objects for managing large scale Virtual Reality environment in real time.
4. Discuss the various solutionsusing Virtual Reality system framework and development tools for industry and social relevant applications.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the components of Augmented Reality and Virtual Reality.	1,10	1
CO2	Apply multimodal user interaction and perception techniques involved in Virtual Reality.	1,2,3,5,10	3
CO3	Develop real world applications using simulation and interactive techniques.	1,2,3,5,10,11	2,3
CO4	Choose the innovative Virtual Reality solutions for industrial and Social relevant applications.	1,10,11	1
CO5	Evaluate current trends of AR and VR media delivery to propose options to potential clients, and discuss the benefits, challenges and misconceptions involved with working in AR and VR.	1,8,12	1,2
CO6	Evaluate various interaction schemes common to AR/VR experiences.	9,12	2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3									3			3		
CO2	3	3	3		3					3					3
CO3	3	3	3		3					3	2			3	3
CO4	3									3	2		3		
CO5	2							2					1	2	
CO6	1		2						2					2	

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Introduction to Augmented Reality (AR): Definition and Scope, A Brief History of Augmented Reality, Examples, Related Fields, System Structure of Augmented Reality,Key Technology in AR. **Introduction to Virtual Reality (VR):** Fundamental Concept and Components of VR, Primary Features and Present Development on VR.
UNIT-2
Multiple Models of Input and Output Interface in VR: Input – Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus and 3D Scanner. Output – Visual, Auditory, Haptic Devices.
UNIT-3
Environment Modeling in VR: Geometric Modeling, Behavior Simulation, Physically Based Simulation. **Interactive Techniques in VR:** Body Track, Hand Gesture, 3D Manus, Object Grasp.
UNIT-4
Development Tools and Frameworks in VR: Frameworks of Software Development Tools in VR, X3D Standard, Vega, MultiGen, Virtools, Unity. **Application of VR in Digital Entertainment:** VR Technology in Film and TV Production, VR Technology in Physical Exercises and Games, Demonstration of Digital Entertainment by VR.

TEXT BOOKS:

1. Dieter Schmaltzier and Tobias Hollerer. Augmented Reality: Principles and Practice, Addison-Wesley, 2006.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.

REFERENCE BOOKS:

1. Sherman, William R. and Alan B. Craig, Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2. Fei GAO, Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
3. Guangran LIU, Virtual Reality Technology, Tsinghua Press, Jan. 2011.

JOURNALS/MAGAZINES

1. 1.International Journal of Virtual and Augmented Reality (IJVAR), https://www.igi-global.com/journal/international-journal-virtual-augmented-reality/145080
2. Springer, Virtual Reality, https://www.springer.com/journal/10055

SWAYAM/NPTEL/MOOCs:

1. https://www.mooc-list.com/tags/virtual-reality
2. https://nptel.ac.in/courses/106/106/106106138/

SELF-LEARNINGEXERCISES:

Unity 3D, Manus

Course Title	System Modeling and Simulation (PE-V)				Course Type		Theory	
Course Code	B20EKS703	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

System modelling is a process of development of a model for a real world operation. Model is built to check the feasibility of implementation of the real world applications. Simulation is the imitation of the operation of a real world system that gives information about the system being investigated. . The system may be electrical, electronic, industrial, and chemical. The activities of the model consist of events, or inputs and outputs, which are activated at certain points in time and in this way affect the overall state of the system.

COURSE OBJECTIVE:

The objectives of this course are to:

1. Explain the concept of simulation along with single channel and multichannel queuing system.
2. Illustrate the working of discrete event system and manual simulation with respect to event scheduling algorithm.
3. Discuss random number generation and variates with different testing techniques.
4. Describe how to model, calibrate, verify and validate a software model along with simulation

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Make use of the simulation tools in real world applications.	1,2,3,4,5	1
CO2	Analyse the concept of scheduling with respect to time and events simulation analysis.	1,2,3,4,5	1
CO3	Identify a suitable random variate method for solving given real world problems.	1,2,3,4,5	2,3
CO4	Compare Verification and Validation of simulation models for given real world data.	1,2,3,4,5	1
CO5	Learn new tools and technologies in the system modeling and simulationand apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldsystem modeling and simulation to the complex problems, either individually or as a part of the team	5,9,10	2

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, Discrete Event system simulation, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System.

UNIT-2
General Principles: Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling, list processing. **Statistical models in simulation:** Review of terminology and concepts; Useful statistical models, Discrete distribution: Bernoulli distribution, Binomial distribution, Geometric and Poisson distribution. Continuous distribution: Uniform distribution, Exponential distribution and normal distribution.
UNIT-3
Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test. **Random Variate Generation:** Inverse Transform Technique- Exponential, Uniform distributions, direct transformation for Normal and log normal Distributions, convolution methods- Erlang distribution, Acceptance Rejection Technique.
UNIT-4
Analysis of Simulation Data **Input Modelling**: Data collection, Identification and distribution with data, parameter estimation, Goodness of fit tests, Selection of input models without data, Multivariate and time series analysis. **Verification and Validation of Model**: Model Building, Verification, Calibration and Validation of Models.

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, Discrete-Event System Simulation,Pearson Education, 4th Edition, 2007.
2. Lawrence M. Leemis, Stephen K. Park,Discrete – Event Simulation: A First Course Pearson Education/ Prentice-Hall India, 2006.

REFERENCE BOOKS:

1. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1991
2. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition.
3. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/5679170
2. https://link.springer.com/book/10.1007/978-4-431-49022-7

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/112/107/112107214/
2. Modelling and Simulation-Coursera

SELF-LEARNINGEXERCISES:

Types of simulations with respect to output analysis;Output analysis for terminating simulations; Output analysis for steady-state simulations.

Course Title	Python for Data Science (OE-III)				Course Type		Theory	
Course Code	B20CIO701	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course covers fundamentals of Python programming, data preprocessing, sampling methods, Data Visualization techniques, it involves developing a methods to analyzing data effectively to extract useful information and statistical method used in statistical decision using experimental data.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain the fundamentals of python programming
2. Discuss the data science and issues of Data science.
3. Describe the methods and programming tips of handling large data
4. Summarize the fundamentals of statistics and various Data Visualization techniques.

COURSE OUTCOMES(COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Apply the concepts of python programming to develop simple applications.	1,2,3,4,5	1,2
CO2	Make use of the concepts of data science for solving real world problem.	1,2,3,4,5	1,2
CO3	Identify the techniques which are suitable to handle large volumes of data for distributed data storage.	1,2,3,4,5	1,2
CO4	Analyze the results obtained using various visualization techniques on given data.	1,2,3,4,5	3
CO5	Learn new tools and technologies in the python for data science and apply for suitable application development.	12	2

CO6	Develop solutions in the related field of python for data science to the complex problems, either individually or as a part of the team and report	5,9,10	2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	2	1								3	3	
CO2	2	2	1	2	2								3	3	
CO3	2	2	2	1	2								3	3	
CO4	2	2	1	2	2								3	3	

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

COURSE CONTENT

THEORY:

CONTENTS

UNIT- 1
Introduction to concepts of OOPs: Objects and Classes, Data Abstraction, Encapsulation, Polymorphism and Inheritance. Difference between OOP and POP. Python IDEs **Your First Python Program:** Diving in; Declaring Functions; Optional and Named Arguments, Writing Readable Code, Documentation Strings, The import Search Path, Everything Is an Object, What's an Object?, Indenting Code, Exceptions, Catching Import Errors, Unbound Variables, **Native Data types:** Booleans, Numbers, Coercing integers to Floats and Vice Versa, Numbers in a Boolean Context, Lists, Tuples, Sets, and Dictionaries **Comprehensions:** Working with Files and Dictionaries, List Comprehensions, Dictionary Comprehensions, Set Comprehensions
UNIT- 2
Introduction: Introduction to Data Science: Definition: Big Data and Data Science Hype, Why Data Science, Getting Past the Hype, Current Landscape, Who is Data Scientist?, Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration, Data modeling , Presentation.
UNIT -3
Handling large data on a single computer: The problems you face when handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Case study 1: Predicting malicious URLs, Case study 2: Building a recommender system inside a database. First Steps in Big data: Distributing data storage and processing with Frameworks, Case study: Assessing risk when loaning money.
UNIT- 4
Statistics: Introduction, Types of Statistics. Data Visualization and Interpretation: Histogram, Bar Charts, Scatter Plots, Good vs. Bad Visualization. Sampling distributions; Point estimation - estimators, minimum variance unbiased estimation, maximum likelihood estimation, method of moments, consistency; Interval estimation.

TEXTBOOKS:

1. Mark Pilgrim, "Dive into Python 3", Apress special edition, second edition, 20l5.
2. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st edition, 2016.
3. Travis E. Oliphant, "Guide to NumPy", Trelgol publishers,2006.
4. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann, 2011.
5. William Navidi ,"Statistics for Engineers and Scientists", McGraw Hill Education, India, 3rd Edition, 2013.

REFERENCEBOOKS:

1. 1.Mark Lutz, "Learning Python", Oreilly.2003.
2. John M. Zelle, "PYTHON Programming: An Introduction to Computer Science", Franklin, Beedle& Associates, 2009.
3. Michael Dawson, "Python Programming for the Absolute Beginners", 3rd Edition, CENAGE Learning, 2011.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007.
5. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter Economy Edition,

Prentice Hall of India, 2016.

JOURNALS/MAGAZINES

1. https://datascience.codata.org
2. https://www.springer.com/journal/41060
3. https://ieeexplore.ieee.org/document/8757088
4. https://www.ijcseonline.org/pub_paper/57-IJCSE-03229.pdf

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_cs33/preview
2. Python for Data Science, AI & Development -Coursera

SELF-LEARNINGEXERCISES:

Data Science using R,Creating own datasets, functions and packages in R and using packages in R

Course Title	Deep Learning (OE-III)				Course Type		Theory	
Course Code	B20CIO702	Credits	3		Class		VII semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-				
	Tutorial	-	-	-	Theory	Practical	CIE	SEE
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW:

This course is an introduction 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 OBJECTIVE (S):

The objectives of this course are to:

1. Explain the basic concepts of Deep Learning.
2. Describe supervised and unsupervised learning.
3. Demonstrate the use of a deep learning neural network in a real world application.
4. Illustrate the use of deep learning techniques in neural networks and natural language processing

COURSE OUTCOMES (COs)

After the completion of the 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.	1,2,3,4	1,2
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	1,3,4,5,8	1,2
CO3	Utilize deep learning neural network model on real time applications.	1,3,4,5,8	1,3
CO4	Develop Recommender systems applications using CNN concepts of NLP.	1,2,4,5	1
CO5	Learn new tools and technologies in the deep learningand apply for suitable application development.	12	2
CO6	Develop solutions in the related field of deep learning to the complex problems, either individually or as a part of the team and	5,9,10	2

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
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.

TEXT BOOKS:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." First edition, An MIT Press book in preparation, 2015.

REFERENCE BOOKS:

1. Duda, R.O., Hart, P.E., and Stork, D.G. “Pattern Classification”, Wiley-Interscience. 2nd Edition. 2001.
2. Theodoridis, S. and Koutroumbas, K. ,”Pattern Recognition”, Edition 4. Academic Press, 2008.
3. Russell, S. and Norvig, N. ,”Artificial Intelligence: A Modern Approach”, Prentice Hall Series in Artificial Intelligence. 2003.

JOURNALS/MAGAZINES

1. Springer Journal of Machine Learning, https://www.springer.com/journal/10994
2. http://ieeexplore.ieee.org/document/8297269/

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/courses/106/105/106105215/
2. https://www.my-mooc.com/en/categorie/deep-learning
3. Deep Learning Specialization-Coursera

SELF-LEARNINGEXERCISES:

Linear factor Models, Structured probabilistics Models, Monte-Carlo Methods, Deep generative Mod

Detailed Syllabus

Semester-8

Course Title	IoT Programming				Course Type		Theory	
Course Code	B20CI0801	Credits	3		Class		VIII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

The course covers the importance of IoT in society, the current components of typical IoT devices and trends for the future. IoT design considerations, constraints and interfacing between the physical world and your device will also be covered. This course will get to know how to make design trade-offs between hardware and software. It also covers key components of networking to ensure that students understand how to connect their device to the Internet.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Explain basics of Arduino programs.
2. Illustrate sample programs to interface sensors to aurdino board storead, process and analyze data.
3. Demonstrate WebApp storead and stored at a from sensors, and to monitor and control IoT devices.
4. Discuss IoT programming to develop larger smart products useful for the society.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Develop programs to interface sensors to Aurdino board stored, process and analyze data.	1,2,3,4,5,6	3
CO2	Analyse the performance of Communication Protocols used in real time IoT Projects.	1,2,3,4,5,6	1
CO3	Make use of different IoT Patterns to develop the real world applications.	1,2,3,4,5,6	1
CO4	Identify the IoT security requirements to solve the given real world problem.	1,2,3,4,5,6	1
CO5	Learn new tools and technologies in the **IoT Programming** and apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldof **IoT Programming** to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	2

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#/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	2									3
CO2	2	3	3	2	2	3							3		
CO3	3	3	2	2	3	3							3		
CO4	3	3	3	3	3	2							3		
CO5												2		2	
CO6					3				2	2				2	

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT- 1
Building Blocks: Arduino Basics, Hardware Requirements, Software Requirements: Toolbar, StatusWindow, Serial Monitor Window; Arduino Programming Language Reference Internet Connectivity:ArduinoUno Wired Connectivity (Ethernet), Hardware Required, Software Required Circuit, Code(Arduino), Final Product; ArduinoUno Wireless Connectivity(WiFi), Hardware Required, Software Required, Circuit, Code (Arduino), FinalProduct **Communication Protocols:** HTTP: Code (Arduino), Final Product; MQTT: Intrusion Detection System, Remote Lighting Control, Code (Arduino), Final Product
UNIT -2
Complex Flows: Node-RED:HardwareRequired, Software Required, Circuit, Node-REDFlow, Code (Arduino), External Libraries, Internet Connectivity (Wireless),Read Sensor Data, Data Publish, Standard Functions and the FinalProduct. **IoT Patterns:** Real-time Clients: Hardware Required, Software Required, Circuit, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions, Code (Android): Project Setup, Screen Layout, Screen Logic, MQTT Client and the Final Product. **IoT Patterns: Remote Control:** Hardware Required, Software Required, Circuit, Code (Android): Project Setup, Screen Layout, Screen Logic; MQTTClient,Code(Arduino):External Libraries, Internet Connectivity(Wireless) ,Data Subscribe, Control Lights, Standard Functions and the Final Product.
UNIT- 3
IoT Patterns: On-Demand Clients: Hardware Required, Software Required, Circuit, Database Table(MySQL), Code(PHP): Database Connection, Receive and Store Sensor Data, Get the Parking Spot Count; Code(Arduino): External Libraries, Internet Connectivity(Wireless), Read Sensor Data;Code(iOS): Project Setup, Screen Layout, Screen Logic and the Final Product. **IoT Patterns: Web Apps**: Hardware Required, Software Required, Circuit, Database Table (MySQL),Code(PHP): Database Connection, Receive and Store Sensor Data, Dashboard; Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions and the FinalProduct. **IoT Patterns: Location Aware:** Hardware Required, Software Required, Circuit, Database Table(MySQL),Code(PHP):Database Connection, Receive and Store Sensor Data, Map; Code (Arduino):External Libraries, Get GPSCoordinates, Data Publish, Standard Functions and the Final Product.

UNIT-4

IoT Patterns: Machine to Human: Hardware Required, Software Required, Circuit, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions, Effektif Workflow: Process Creation, Process Configurations; Node-RED Flow and the Final Product.

IoT Patterns: Machine to Machine: Light Sensor Device, Code (Arduino): Lighting Control Device, Code (Arduino) and the Final Product

IoT Platforms: Hardware Required, Software Required, Circuit, Xively Setup, Zapier Setup, Xively Trigger, Code (Arduino): External Libraries, Internet Connectivity (Wireless), Read Sensor Data, Data Publish, Standard Functions and the Final Product.

Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT -

Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities - Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption - Attack & Fault trees

TEXT BOOKS:

1. Adeel Javed,"Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications",Apress,2015.

2. BrianRussell, DrewVanDuren,"PracticalInternetofThingsSecurity(KindleEdition)",2016

REFERENCE BOOKS:

1. Agus Kurniawan, "Smart Internet of Things Projects ", Packt Publishing,2016.

JOURNALS/MAGAZINES

1. https://www.researchgate.net/publication/266854342_On_IoT_programming
2. https://jisajournal.springeropen.com/about/new-content-item
3. https://ieeexplore.ieee.org/document/8628483/
4. https://ieeexplore.ieee.org/document/8845363

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. An Introduction to Programming the Internet of Things (IOT) Specialization -Coursera

SELF-LEARNINGEXERCISES:

Explore any one of the boards like Raspberry Pi, Intel Galileo, Beagle Bone Black, Dragon Board, UDOO DUAL/QUAD, ARM Boards, DIY Development boards for IoT prototyping (C.H.I.P, MediatekLinkit One, Particle Photon, Tessel, Adafruit Flora, LightBlue Bean, Udoo Neo, Intel Edison)

Course Title	Reinforcement Learning				Course Type		Theory	
Course Code	B20CIO802	Credits	3		Class		VIII Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	13Hrs/ Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	-	-	-	Theory	Practical	CIE	SEE
	Tutorial	-	-	-				
	Total	**3**	**3**	**3**	**39**	**0**	**50**	**50**

COURSE OVERVIEW

This course covers fundamental principles and techniques in deep and reinforcement learning. Topics include convolutional neural networks, recurrent and recursive neural networks, backpropagation algorithms, regularization and optimization techniques for training such networks, dynamic programming, Monte Carlo, and temporal difference, and function approximation reinforcement learning algorithms, and applications of deep and reinforcement learning.

COURSE OBJECTIVE (S):

The objectives of this course are to:

1. Describe back propagation algorithms to train deep neural networks and apply regularization techniques.
2. Explain optimization techniques to train deep neural networks and convolutional neural networks.
3. Discuss recurrent neural networks to analyze basic deep learning algorithms for speech recognition, face recognition, object recognition and NLP.
4. Demonstrate reinforcement learning algorithms for real time applications.

COURSE OUTCOMES (COs)

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

CO#	Course Outcomes	POs	PSOs
CO1	Identify the concepts of Deep Feedforward Networks to train deep neural networks.	1,2,3,4,5,6	1
CO2	Utilize optimization techniques in deep neural networks and convolutional neural networks for real world application.	1,2,3,4,5,12	1
CO3	Develop recurrent neural networks algorithm for analysis of NLP applications.	1,2,3,4,5,6,9,12	1
CO4	Solve real world complex problems using reinforcement learning algorithms.	1,2, 4,5 ,6	1,2
CO5	Learn new tools and technologies in the reinforcement learning and apply for suitable application development.	12	2
CO6	Develop solutions in the related fieldof reinforcement learning to the complex problems, either individually or as a part of the team and report the results with proper analysis and interpretation.	5,9,10	2

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

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

COURSE CONTENT

THEORY:

CONTENTS
UNIT-1
Deep Networks:Deep Feedforward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms. Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multitask Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier

UNIT-2
Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms. **Convolutional Networks:** The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks.
UNIT-3
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence, Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, **Applications:** Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing.
UNIT-4
The Reinforcement Learning Problem: Reinforcement Learning, Elements of Reinforcement Learning, Limitations and Scope. Multi-arm Bandits :An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper-Confidence-Bound Action Selection, Gradient Bandits, Associative Search, **Finite Markov Decision Processes** : The Agent–Environment Interface , Goals and Rewards, Returns, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Function, Optimality and Approximation, Dynamic Programming: Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville Deep Learning, MIT Press, 2016.
2. Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction” second edition, the MIT PRESS,2015.

REFERENCE BOOKS:

1. Abhishek Nandy, Manisha Biswas, Reinforcement Learning: With Open AI, TensorFlow and Keras Using Python, Apress,2017.
2. Eugene charniak, Introduction to Deep Learning, The MIT Press, 2018.

JOURNALS/MAGAZINES

1. https://ieeexplore.ieee.org/document/6025669
2. https://ieeexplore.ieee.org/document/7301554

3. https://www.jair.org/index.php/jair/article/view/10166
4. http://www.ijstr.org/final-print/mar2020/A-Study-Of-Reinforcement-Learning-Applications-Its-Algorithms.pdf

SWAYAM/NPTEL/MOOCs:

1. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs27/
2. Reinforcement Learning,Practical Reinforcement Leraning-Coursera

SELF-LEARNING EXERCISES:

Implement and apply Monte Carlo reinforcement learning algorithms, implement and apply temporal-difference reinforcement learning algorithms.

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School of Computer Science and Engineering

HANDBOOK

M. Tech. in Computer Science and Engineering

2020-22

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Chancellor's Message

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

- Nelson Mandela.

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

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

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

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

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

Dr. P. 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

Director's –Message

I congratulate and welcome all the students to the esteemed School of Computer Science and Engineering. You are in the right campus to become a computer technocrat. The rising needs of automation in Industry 4.0 and improvising living standards have enabled rapid development of computer software and hardware technologies. Thus providing scope and opportunity to generate more human resources in the areas of compute rscience. The B.Tech and M.Techprogram curriculum and Ph.D areas in the school are designed to cater to the requirements of industry and society. The curriculum is designed meticulously in association with persons from industries (TCS, CISCO, AMD, MPHASIS, etc.), academia and research organizations (IISc, IIIT, Florida University, Missouri S & T University, etc).This handbook presents the M. Tech in Computer Science and Engineering program curriculum. The program is of 2 years duration and split into 4 semesters. The courses are classified into foundation core, hard core, and soft core courses. Hard core courses represent fundamentals study requirements of CSE. Soft courses provide flexibility to students to choose the options among several courses as per the specialization, such as, AI, Data Science, and Systems. Theoretical foundations of engineering, science, and computer science are taught in first two Semesters. Later, advanced courses and recent technologies are introduced in subsequent semesters for pursuing specialization.

The important features of the M.TechCSE are as follows: 1) Choice based course selection and teacher selection, 2) Studies in emerging areas like Machine Learning, Artificial Intelligence, Data Analytics, Cloud Computing, Python/R Programming, Genetic Engineering, NLP, Swarm Intelligence, IOT and Cybersecurity, 3) Short and long duration Internships 4) Opportunity to pursue MOOC course as per the interest in foundation and soft core courses, 5) Attain global and skill certification as per the area of specialization, 6) Self-learning components, 7) Experiential, practice, practical, hackathons, and project based learning, 8) Mini projects and major projects with research orientation and publication, 9) Soft skills training and 10) Platform for exhibiting skills in cultural, sports and technical activities through clubs and societies.

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

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

Dr. Sunilkumar S Manvi
Director, School of CSE and CIT

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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

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

Mission

- To create state of the art- Computing labs infrastructure and research facilities in Computer Science and Engineering.
- To provide student-centric learning environment in Computer Science and Engineering through innovative pedagogy and education reforms.
- To encourage research, innovation and entrepreneurship in Computer Science and Engineering through industry/academia collaborations and extension activities
- Organize programs through club activities for knowledge enhancement in thrust areas of Computer Science and Engineering.

- To enhance leadership qualities among the youth and enrich personality traits, promote patriotism, moral and ethical values.

Quality Policy

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

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

MEMBERS OF BOARD OF STUDIES

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

Program Overview

M Tech in Computer Science and Engineering

Computer Science and Engineering (CSE) encompasses a variety of topics that relates to computation, like development of algorithms, analysis of algorithms, programming languages, and software design and computer 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.

REVA UNIVERSITY
Bengaluru, India

School of Computer Science and Engineering

Program Educational Objectives (PEO's)

After few years of graduation, the graduates of M. Tech. (Computer Science 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, model, analyze and evaluate the solution and report as a dissertation in the area of Computer Science and Engineering.

REVA University Academic Regulations

M Tech., Degree Programs

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

Regulations - MTech., Degree Program
Academic Year 2020-21 Batch

1. Title and Commencement:

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

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

2. The Programs:

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

M Tech (Full Time) in:
Artificial Intelligence
Computer Science and Engineering
Computer Aided Structural Engineering
Construction Technology & Management
Digital Communication and Networking
Machine Design
Power Energy & Systems
Transportation Engineering and Management
VLSI and Embedded Systems

Also
M Tech (Part Time) in:
Computer Science and Engineering
VLSI and Embedded Systems

3. Duration and Medium of Instructions:

3.1 **Duration:** The duration of the M 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	**Lecture**
T	**Tutorial**
P	**Practice**

Where:

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

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

P stands for **Practice** session and it consists of Hands on Experience / Laboratory Experiments / Field Studies / Case Studies / Project Based Learning or Course end Project/Self Study/ Online courses from listed portals that equip students to acquire the much required skill component.

4.2 Classification of Courses

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

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

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

4.2.3 **Hard Core Course (HC) simply core course:** The **Hard Core Course** is a Core Course in the main branch of study and related branch(es) of study, if any, that the candidates have to complete compulsorily

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

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

4.2.5 **Open Elective Course (OE):**

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

4.2.6 **Project Work / Dissertation:**

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

5. Eligibility for Admission:

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

Sl. No.	Program	Duration	Eligibility
1	Masters of Technology (M Tech) in Artificial Intelligence	4 Semesters (2 years)	B E / B.Tech. in CSE / ISE / TE / MCA / M. Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
2	M Tech in Computer Science and Engineering	**Full Time** – 4 Semesters (2 years) **Part Time** – 5 Semesters (3 years)	B E / B.Tech. in ECE / IT / EEE / CSE / ISE / TE / MCA / M.Sc. in Computer Science or Mathematics or Information Science or Information Technology with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.
3	M Tech in Computer Aided Structural Engineering Construction Technology & Management Transportation Engineering and Management	6 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 Machine Design	4 Semesters (2 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.
6	M Tech in VLSI and Embedded Systems	**Full Time** – 4 Semesters (2 years) **Part Time** – 6 Semesters (3 years)	B E / B.Tech. in ECE /TE / EEE / CSE / ISE / Instrumentation Technology / Medical Electronics/M Sc in Electronics with a minimum of 50% (45% in case of SC/ST) marks in aggregate of any recognized University/Institution or AMIE or any other qualification recognized as equivalent there to.

7	M Tech in Machine Design	4 Semesters (2 years)	BE / B.Tech. in Mechanical/Aeronautical / Automobile / Industrial Production Engineering with a minimum of 50% (45% in case of candidate belonging to SC/ST category) marks in aggregate, of any recognized University / Institution or AMIE or any other qualification recognized as equivalent there to.

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

6. Courses of Study and Credits

6.1 Each course of study is assigned with certain credit value

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

6.3 The credit hours defined as below

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

1 credit = 13 credit hours spread over 16 weeks or spread over the semester

The total duration of a semester is 20 weeks inclusive of semester-end examination.

The following table describes credit pattern

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

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

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

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

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

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

8. Credit and Credit Distributions:

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

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

8.3 Only 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:

Assignment & Seminars…….. 10 marks for the first 20% of the syllabus
Test (Mid-Term) ……..15 marks for the first 30% of the syllabus
Total …… ……..25 marks

(ii) Component IA2:

The second component (IA2), of assessment is for 25 marks. This will be based on test, assignment /seminar. The continuous assessment and scores of second half of the semester (9th to 16th week) will be consolidated during 16th week of the semester. During the second half of the semester the remaining

units in the course will be completed. A review test based on IA2 will be conducted and completed during 16th week of the semester. In case of courses where test cannot be conducted, the form of assessment will be decided by the concerned school and such formalities of assessment will be completed during 16th week.

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

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

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

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

Total ……..25 marks

(iii) Component SEE:

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

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

Component	Period	Syllabus	Weightage	Activity
IA1	1st Week to 8th Week	First 50% (two units)		Instructional process and Continuous Assessment
	Last 3 days of 8th Week		25%	Consolidation of IA1
IA2	9th week to 16th week	Second 50% (remaining two units)		Instructional process and Continuous Assessment
	Last 3 days of 16th week		25%	Consolidation of IA2
SEE	17th and 18th week			Revision and preparation for Semester end examination
	19th week to 20th week	Entire syllabus	50%	Conduct of semester end examination and Evaluation concurrently
	21st week			Notification of Final Grades
***Evaluation shall begin very first day after completion of the conduct of examination of the first course and both examination and evaluation shall continue concurrently. The examination results / final grades be announced latest by 21st week**				

Note: 1. Practical examination wherever applicable shall be conducted before conducting of IA2

examination. The calendar of practical examination shall be decided by the respective school.

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

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

9.3.1 **For > 3 credit courses**

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

9.3.2 **For 1 & 2 credit courses**

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

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

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

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

For example:

During IA1

Laboratory work …….. 10 marks

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

Total …… ……..25 marks

During IA2

Laboratory work …….. 10 marks

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

Total …… ……..25 marks

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

10. Setting Questions Papers and Evaluation of Answer Scripts:

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

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

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

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

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

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

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

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

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

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

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

13. Requirements to Pass a Course

13.1 A candidate's performance from all 3 components will be in terms of scores, and the sum of all three scores will be for a maximum of 100 marks (25 + 25 + 50). A candidate who secures a minimum of 40% in the SEE and an overall 40% (IA1+IA2+SEE) in a course is said to be successful.

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

Marks, P	Grade, G	Grade Point (GP=V x G)	Letter Grade
90-100	10	v*10	O
80-89	9	v*9	A+
70-79	8	v*8	A

60-69	7	v*7	B+
55-59	6	v*6	B
50-54	5.5	v*5.5	C+
40-49	5	v*5	C
0-39	0	v*0	F
ABSENT			AB

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

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

a. Computation of SGPA and CGPA

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

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

SGPA (Si) = ∑(Ci x Gi) / ∑Ci

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

b. Illustration for Computation of SGPA and CGPA

Illustration No. 1

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

Thus, **SGPA = 184 ÷ 22 = 8.36**

c. Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (72) for two year post graduate degree in a specialization is calculated taking into account all the courses undergone by a student over all the semesters of a program, i. e

CGPA = ∑(Ci x Si) / ∑Ci

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

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

Illustration:
CGPA after Final Semester

Semester (ith)	No. of Credits (Ci)	SGPA (Si)	Credits x SGPA (Ci X Si)
1	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

Thus, **CGPA** = $\frac{22x8.36+22x8.54+16x9.35+12x9.50}{72}$ = 8.83

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	
> 4 CGPA <5	5	C	Satisfactory	Pass
< 4 CGPA	0	F	Unsatisfactory	Unsuccessful

Overall percentage=10*CGPA

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

b. **Final Grade Card:** Upon successful completion of the Post Graduate Degree a Final Grade card consisting of grades of all courses successfully completed by the Candidate will be issued by the COE.

15. Attendance Requirement:

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

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

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

16. Re-Registration and Re-Admission:

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

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

17. **Absence during Internal Test:**

In case a student has been absent from an internal tests due to the illness or other contingencies he /

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

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

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

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

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

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

19. Provision for Supplementary Examination

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

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

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

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

21. **Provision for Appeal**

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

22. **Grievance Committee:**

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

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

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

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

M. Tech in Computer Science and Engineering

Scheme of Instructions

(Effective from the Academic Year 2020-21)

Sl. No	Course Code	Course Title	Course Type	Credit Pattern and Credit Value				No. of Hrs.
				L	T	P	C	
FIRST SEMESTER								
1	M20TC0101	Advanced Database Management Systems	HC	3	0	0	3	3
2	M20CS0101	Advanced Machine Learning	HC	3	0	1	4	5
3	M20TC0102	Advanced Java Programming	HC	3	0	0	3	3
4	M20TC0103	Advanced Algorithms	HC	3	0	0	3	3
5	M20TC0104	Internet of Things	HC	3	0	1	4	5
6	M20CI0101	Python for Artificial Intelligence	HC	2	0	1	3	4
7	M20TC0105	Mini Project	HC	0	0	2	2	4
Total Credits for the First Semester							**22**	**27**
SECOND SEMESTER								
1	M20TCS211	Cloud Computing Tools	SC	2	0	1	3	4
	M20TCS212	Advanced Web Technologies						
	M20TCS213	Distributed Computing						
2	M20TCS221	Big data Analytics	SC	3	0	1	4	5
	M20TCS222	Wireless and Mobile Networks						
	M20TCS223	User Interface (UI)/ User Experience (UX) Design						
3	M20TCS231	Unix System Programming	SC	3	0	1	4	5
	M20TCS232	Mobile Application Development						
	M20TCS233	Python for Data Analysis						
4	M20TCS241	High Performance Computing	SC	3	0	1	4	5
	M20TCS242	Program Analysis						
	M20TCS243	Block Chain Technology						
5	M20TCS251	Robotic Process Automation	SC	3	0	0	3	3
	M20TCS252	Agile Software Development						
	M20TCS253	Deep Learning						
6	M20TC0206	Cyber Security Lab	HC	0	0	2	2	4
7	M20TC0207	Mini Project	HC	0	0	2	2	4
Total Credits for the Second Semester							**22**	**30**

THIRD SEMESTER								
1	M20TCS311	Virtual and Augmented Reality	SC	3	0	1	4	5
	M20TCS312	Computer Vision						
	M20TCS313	Natural Language Processing						
2	M20TCO302	Open Elective	OE	4	0	0	4	4
3	M20TC0303	Project Work Phase-1	HC	0	0	4	4	8
4	M20TC0304	Internship/ Global Certification	HC	0	0	4	4	8
	Total Credits for the Third Semester						**16**	**25**
FOURTH SEMESTER								
1	M20TC0401	Project-Work Phase-2 and Dissertation	HC	0	0	12	12	28
	Total Credits for the Fourth Semester						**12**	28
Total Credits for all Four Semesters is 72.								

Note: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.

I Year

Detailed Syllabus

I Semester
Syllabus

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Database Management Systems</td><td>Course Type</td><td colspan="2">Theory</td></tr>
<tr><td>Course Code</td><td>M20TC0101</td><td>Credits</td><td colspan="2">3</td><td>Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>0</td><td>0</td><td>0</td><td rowspan="2">Theory</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>3</td><td>3</td><td>39</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT 1

Overview of DBMS and SQL: Introduction to DBMS and SQL, SQL Data Definition and Data Types, Schema change statements in SQL, Specifying basic constraints in SQL, Basic Queries in SQL, More Complex Queries in SQL, General Constraints as Assertions, Views in SQL, Database Programming, Embedded SQL

UNIT- 2

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

UNIT -3

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

UNIT- 4

Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; OLAP - OLAP Architecture, Relational OLAP , Multidimensional OLAP , Relational vs. Multidimensional OLAP , Web based OLAP Major features & functions , Drill-Down and Roll-Up , Slice-and-Dice or Rotation

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Raghu Ramakrishnan and Johannes Gehrke " Database Management Systems", McGraw- Hill, 2003.

2. Elmasri and Navathe, "Fundamentals of Database Systems", Pearson Education, 2007.

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, McGraw Hill, 2010.
2. C J Date, “Database Design and Relational Theory, Normal Forms and All that Jazz”, O ‘Reilly.inc 2012.
3. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining: Concepts and Techniques”, Elsevier, 2011.
4. Connolly and Begg, “Database Systems”, Pearson Education, 2002.

JOURNALS/MAGAZINES

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

SWAYAM/NPTEL/MOOCS:

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

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Machine Learning</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20CS0101</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

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

UNIT-2

Learning with trees (contd...): Boosting, Bagging, Random Forest, Different ways to combine Classifiers Probabilistic Learning – Gaussian Mixture Models, Nearest Neighbor Methods [2]

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

UNIT-3

Linear models: Perceptron, Linear Separability, Linear Regression.

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

UNIT-4

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

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

Unsupervised learning: Classification, Association

SELF- LEARNING:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)” Third Edition, MIT Press, 2014
2. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
3. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014

JOURNALS/MAGAZINES:

1. IEEE Transactions on Pattern Analysis and Machine Intelligence
1. Springer Journal of Machine Learning
2. Elsevier Journal of Machine Learning with Applications

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

Sl.No.	List of Programs
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 Pacakages.
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 examplesl.* Implemrent the Find-S algorithm that starts with the most specific hypothesis.
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.
4.	LINEAR REGRESSION: It is regression technique which try 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.
5.	NAIVE BAYES: It is probabilistic approach undergoes bayes rule. Apply Navie Bayes algorithm using Gethub dataset for classification model on Flowers.
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.
7.	K-MEANS: K-Means Clustering is an Unsupervised Learning algorithm, which groups the unlabelled dataset into different clusters.Implement KNN to calculate the variance and place a new centroid of each cluster
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.

Course Title	Advanced Java Programming				Course Type	Theory	
Course Code	M20TC0102	Credits	3		Class	I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-	Practical		
	Total	3	3	3	39	50	50

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Describe the advanced concepts of java programming.
2. Explain the concepts used for developing web application.
3. Discuss different session management techniques used in web pages.
4. Demonstrate the establishment of communication between application and databases.

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS: **UNIT-1**

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

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

UNIT-2

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

UNIT-3

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

UNIT-4

JSP, RMI : Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects. Java Remote Method Invocation: Remote Method Invocation concept; Server side, Client side. IDE: Eclipse IDE, Netbeans IDE &Myeclipse IDE; Servers: Apache Tomcat Glassfish Server, JBoss Server & Weblogic Server. Functional Interfaces, Lambda Expressions, Working with Collections, Stream APIs (Streams and Collectors) and Socket Programming

SELF-LEARNING COMPONENT:

JAVA Model-View-Controller Pattern & Spring Framework.

TEXT BOOKS:

1. Bryan Basham, Kathy Sierra & Bert Bates, “Head First Servlets & JSP”, O’Reilly 2nd Edition.1999
2. Barry J. Holmes and Daniel T. Joyce, “Object-Oriented Programming With Java”, Second Edition, Jones And Bartlett Publishers,2000
3. Dale Skrien, “Object-Oriented Design Using Java”, McGraw-Hill Higher Education,2009
4. Danny Poo, “Object-Oriented Programming and Java”, Second Edition; Springer, 2008.

REFERENCE BOOKS:

1. Cay Horstmann “Big Java”, John Wiley and Sons 2nd Edition, 2001
2. Herbert Schildt, “The Complete Reference Java J2SE”, 5th Edition, TMH Publishing Company Ltd, New Delh

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCS:

1.https://onlinecourses.nptel.ac.in/noc19_cs84/preview

2. https://nptel.ac.in/courses/106/105/106105191/

Course Title	Advanced Algorithms				Course Type	Theory	
Course Code	M20TC0103	Credits	3		Class	I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-			
	Total	3	3	3	39	50	50

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT-4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. T. 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	Internet of Things				Course Type		Integrated	
Course Code	M20TC0104	Credits	3		Class		I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	3	5	5	39	26	50	50

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain the basics of embedded systems and embedded system design.
2. Describe Internet-of-Things and design principles.
3. Demonstrate the use of prototyping in development of real world application.
4. Illustrate the use of internet principles and techniques for writing embedded code.

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System

UNIT-3

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

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

UNIT-4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", ISBN 978-81-265-5686-1 Wiley Publication, 2013
2. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, 2013

JOURNALS/MAGAZINES

1. IEEE Transactions on Internet of Things
2. Springer Journal of Internet of Things
3. Elsevier Journal of Internet of Things
4. IEEE Transactions on Wireless Communications
5. IEEE Sensors Journal
6. IEEE Internet of Things Journal
7. Elsevier, Journal of Network and Computer Applications,
8. Elsevier, Computer Law & Security Review
9. ACM, ACM Transactions on Internet Technology (TOIT)

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

SL.NO	List of Programs
1	There are lots of ways to control DC motors with an Arduino. But one of the easiest and most popular is with an L293D motor driver. The L293D motor driver is designed specifically to control DC motors, stepper motors, solenoids, and any other load with a high impedance. One of its main advantages is that it can control. Design and construct a module to drive DC motor clockwise and anti-clockwise using L293D with Arduino board.
2	Interfacing is the first step to create any useful project. So why don't we create an RFID based Access Control System or an RFID based Door Lock using Arduino? The system I have designed here is a simple version of the project. This project can be enhanced with a lot of features (which I will be doing in the next version of this project – Advanced RFID based Door Lock). Design and construct a module to build a RFID based Access Control System or an RFID based Door Lock using Arduino and display lock status on LCD.
3	The ESP8266 has been a growing star among IoT or WiFi-related projects. It's an extremely cost-effective WiFi module that – with a little extra effort – can be programmed to build a standalone web server. Design a module to control an LED from Webserver using NodeMcu or Esp8266 programming with Arduino IDE.
4	Most new cars today come with a host of advanced safety features including automated systems that assist the drive in maintaining control of the car and warning the driver of possible dangers. The problem, however, is that while these kinds of features greatly increase the safety of a car, they are exorbitantly expensive and only available in new, high-end cars not in old, low-end cars. Design a module for non-contact object detection using Arduino and proximity sensor (Car proximity alert).
5	To designing a intelligent "Graden Computer" with an optional digital plant moisture sensor/water pump controller that lights an LED to alert the user when it is time to water a potted plant, and/or turn on a water pump to quench the thirst, here is an Arduino Primer for you. No doubt, an Arduino can convert your favorite pots into self-watering planters, keeping your plants from drying out and reducing the time you spend watering. Design an intelligent Garden Computer with Arduino and soil moisture sensor that lights an LED to alert the user when it is time to water a potted plant.
	PART-B (IoT Projects)
6	The Arduino Yun solves that problem. The Yun is an Arduino with WiFi built in. Additionally, the Yun has a second microprocessor that runs a lightweight version of Linux and comes with Python preinstalled. This means that for $75, you can have sensors and buttons trigger Python scripts, and Python scripts trigger LEDs, motors and other actuators. And Python's just the language that comes with it — you can install Ruby, Node or PHP if that's your jam. Set up ArduinoYún to connect to WiFi
7	To control your room's temperature, we can build a smart temperature controller. In this case, we use a **PID** (**proportional–integral–derivative**) controller. When you set a certain temperature, a PID controller will change the temperature by turning either cooler or hotter. A PID controller program is developed using Python, which runs on the Raspberry Pi board. Build a smart temperature controller for your room

8	Dedicated control over room temperature is not only a key issue in providing work conditions that ensure employee satisfaction and hence increased work output; it is now a health and safety issue. The design considered the flexibility of using a microcontroller, PIC16F876A along with other peripheral devices such as LM35 temperature sensor, LCD display unit to form all-encompassing single system Build your own decision system based-IoT
9	Tracking multiple objects through video is a vital issue in computer vision. It's used in various video analysis scenarios, such as visual surveillance, sports analysis, robotic navigation, autonomous driving, human-computer interaction, and medical visualization. In cases of monitoring objects of a certain category, such as people or cars, detectors used to make tracking easier. Usually, it is done in two steps: Detecting and Tracking. Build a tracking vision system for moving objects
10	The robot constantly checks to see if it is within 0 meters of the GPS position, if it is then the App display will read "Destination Reached". As you can see sometimes it returns to the correct location and other times it is several feet off. Build a your own car robot based on GPS

<table>
<tr><td>Course Title</td><td colspan="4">Python for Artificial Intelligence</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20CI0101</td><td>Credits</td><td colspan="2">3</td><td colspan="2">Class</td><td colspan="2">I Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>3</td><td>4</td><td>4</td><td>26</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

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

UNIT -2

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

UNIT-3

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

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

UNIT-4

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

SELF –LEARNING COMPONENTS

Artificial neural networks, Machine Learning Techniques

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Stuart Jonathan Russell, Peter Norvig, “Artificial Intelligence For Dummies”, Prentice-Hall, 201

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

PRACTICE:

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

Course Title	Mini Project				Course Type	Practice	
Course Code	M20TC0105	Credits	2		Class	I Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	0	-	-			
	Total	2	4	4	26	50	50

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

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

COURSE OUTCOMES (CO'S):

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

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3	3	3	3	3	3	3	3
CO2							3	3	3	3	3	3	3	3
CO3							3	3	3	3	3	3	3	3
CO4							3	3	3	3	3	3	3	3
CO5							3	3	3	3	3	3	3	3
CO6							3	3	3	3	3	3	3	3
CO7							3	3	3	3	3	3	3	3
CO8							3	3	3	3	3	3	3	3
CO9							3	3	3	3	3	3	3	3
CO10							3	3	3	3	3	3	3	3
CO11							3	3	3	3	3	3	3	3

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

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

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

COURSE CONTENTS:

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

Imagine there is ultimatelybe a 20-iteration project for evolutionary and iterative development. Design an evolutionary requirement analysis and show the diagram for the same 20-iteration project for evolutionary and iterative development.

II Semester
Syllabus

Course Title	Cloud Computing Tools				Course Type		Integrated	
Course Code	M20TCS211	Credits	3		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	2	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	3	5	5	26	26	50	50

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The main objectives of this course are:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT- 1

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

Unit -2

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

UNIT- 3

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

UNIT- 4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Dan C. Marinescu, "Cloud Computing - Theory and Practice", Morgan Kaufmann is an imprint of Elsevier, 2013.
2. BirisLublinsky, Kevin T. Smith and Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN 13:9788126551071, 2015.
3. The Open Replacement for vCloud - Bring your VMware environment to the Cloud in 5 minutes. http://vonecloud.today/ ,http://docs.vonecloud.com/1.8/
4. A complete Guide to Docker. https:// docs.docker.com/get-started/resources/r Documentation
5. A introduction to Kubernetes. https://kubernetes.io/docs/concepts/

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

PRACTICE:

SL.NO	LISTOF PROGRAM
1	This directive is a special purpose directive and is used to turn on or off some features. This type of directives are compiler-specific i.e., they vary from compiler to compiler. Some of the #pragma directives are discussed below: **#pragma startup and #pragma exit**: These directives helps us to specify the functions that are needed to run before program startup(before the control passes to main()) and just before program exit (just before the control returns from main()). Design a Program on #pragrma using C.
2	OpenMP is a library for parallel programming in the SMP (symmetric multi-processors, or shared-memory processors) model. When programming with OpenMP, all threads share memory and data. OpenMP supports C, C++ and Fortran. The OpenMP functions are included in a header file called omp.h. Design a Program using Sections, omp for and omp single
3	Throughput computing focuses on delivering high volumes of computation in the form of transactions. Initially related to the field of transaction processing, throughput computing has since been extended beyond that domain. Throughput computing is realized by means of multiprocessing and multithreading, Multiprocessing is the execution of multiple programs in a single machine, where as multithreading relates to the possibility of multiple instruction streams within the same program. Design a Program using thread private directives.
4	Cloud computing is required by modern technology. Task scheduling and resource allocation are important aspects of cloud computing. Design a Program on scheduling.
5	Cloud computing transforms the way information technology (IT) is consumed and managed, promising improved cost efficiencies, accelerated innovation, faster time-to-market, and the ability to scale applications on demand. Design a Program using last private reduction, copying and shared.
6	A point-to-point communication always involves exactly two processes. One process sends a message to the other. This distinguishes it from the other type of communication in MPI, collective communication, which involves a whole group of processes at one time. Design a Program for Point to Point MPI calls
7	Login to the workshop cluster using user workshop username and OTP token. Copy the exercise files to user home directory. Familiarize user with LC's OpenMP environment. Write a simple "Hello World" OpenMP program. Successfully compile your program. Successfully run your program.Modify the number of threads used to run your program.
8	Login to the LC workshop cluster, if you are not already logged in. Sharing DO/for construct examples: review, compile and run. Work-Sharing SECTIONS construct example: review, compile and run.
9	Login to the workshop cluster. Orphaned directive example: review, compile, run. Get OpenMP implementation environment information .Hybrid OpenMP + MPI programs. Check out the "bug" program
10	**Mininet** is a system that supports the creation of lightweight logical nodes that can be connected into networks. These nodes are sometimes called **containers**, or, more accurately, **network namespaces**. Virtual-machine technology is not used. Install and configure Mininet SDN emulator with 2 traffic engineering experiment applications to understand how to program 'flow spaces' within networks to: (i) comply with enterprise network capacity provisioning policies, and (ii) balance the utilization of network resources – Use Iperf and Ping Tools to verify your SDN functionality

Course Title	Advanced Web Technologies				Course Type		Integrated	
Course Code	M20TCS212	Credits	3		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	2	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	**0**	-	-				
	Total	**3**	**5**	**5**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT- 4

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

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Kogent Learning, “Web Technologies: HTML, JavaScript, PHP, Java, JSP, XML, AJAX – Black Book”, Wiley India Pvt. Ltd, 2009
2. Stuttard D., Pinto M., “The Web Application Hackers Handbook”., Wiley India Pvt. Ltd, 2016.
3. 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/

PRACTICE:

Sl. No.	List of Programs
1	Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, lines and words in the text entered using an alert message. Words are separated with white space and lines are separated with new line character
2	Write a JavaScript program which takes user input as name, stores it in array and sort them alphabetically and displays it using alert box
3	Exception handling is the process of responding to exceptions when a computer program runs. An exception occurs when an unexpected event happens that requires special processing. create an html page named to demonstrate exception handling in JavaScript
4	Assume four users user1, user2, user3 and user4 having the passwords pwd1, pwd2, pwd3 and pwd4 respectively. Write a servlet for doing the following. (i). Create a Cookie and add these four user id's and passwords to this Cookie. (ii). Read the user id and passwords entered in the Login form (week1) and authenticate with the values (user id and passwords) available in the cookies. If he is a valid user (i.e., user-name and password match) you should welcome him by name (user-name) else you should display "You are not an authenticated user ". Finding Related Forum Posts through Content Similarity over Intention-based Segmentation
5	JavaScript is mainly designed to add interactivity in the HTML pages. A JavaScript can be executed when an event occurs, like when a user clicks on an HTML element. To execute code when a user clicks on an element, add JavaScript code to an HTML event attribute Simple web application such as calculator, calendar can be developed using JavaScript. Design a scientific calculator using java script
6	Install a database (Mysql or Oracle). Create a table which should contain at least the following fields: name, password, email-id, phone number Write a java program/servlet/JSP to connect to that database and extract data from the tables and display them. Insert the details of the users who register with the web site, whenever a new user clicks the submit button in the registration page
7	User authentication is very common in modern web application. It is a security mechanism that is used to restrict unauthorized access to member-only areas and tools on a site. In this context, write a program to create a simple registration and login system using the PHP and MySQL and validate the user's authenticity
8	Create tables in the database which contain the details of items (books in our case like Book name, Price, Quantity, Amount) of each category. Modify your catalogue page (week 2) in such a way that you should connect to the database and extract data from the tables and display them in the catalogue page using PHP
9	The user may add some items to cart from the catalogue page. He can check the cart page for the selected items. He may visit the catalogue again and select some more items. Here our interest is the selected items should be added to the old cart rather than a new cart. Multiple users can do the same WEB TECHNOLOGIES LAB MANUAL jdirectoryjkmaterialzjkd thing at a time (i.e., from different systems in the LAN using the IP-address instead of local host). This can be achieved through the use of sessions. Every user will have his own session which will be created after his successful login to the website. When the user logs out his session should get invalidated, modify your catalogue and cart PHP pages to achieve the above mentioned functionality using sessions
10	Create appropriate web page for the following self-descriptive user friendly services. E-Visa Processing & Follow Up System

Course Title	Distributed Computing				Course Type		Integrated	
Course Code	M20TCS213	Credits	3		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	2	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	**3**	**5**	**5**	**26**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain the various distributed systems and its architectures
2. Discuss various communication aspects in the distributed systems
3. Describe the consistency and replication, fault tolerance and security aspects
4. Illustrate the use of Distributed-Object based Systems, Distributed File Systems and Distributed Web-based Systems in real world applications.

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

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

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

UNIT-2

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

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

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

UNIT-3

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

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

Security: Introduction; secure channels; access control; security management

UNIT-4

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

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

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Andrew S. Tanenbaum, "Distributed Operating System*",* Pearson, 2008.
2. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems: Concepts and design*",*Pearson*,* 2011.

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCs:

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

PRACTICE:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">Big Data and Analytics</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS221</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

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

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

.**BLOOM'S LEVELOF THECOURSE OUTCOMES**

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT–1

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

UNIT-2

Big Data Processing with MapReduce: 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/

PRACTICE:

Sl. No.	List of Programs
1	Hive is a data warehousing infrastructure tool built on the top of Hadoop. This article helps you to start quickly with the Hive by providing guidance about downloading Hive, setting and configuring Hive and launching HiveServer2, and the Beeline Command shell to interact with Hive. Installing Hadoop 3, Hive, Derby, R, Anaconda, Python, Apache Spark, Apache Flink, Tableu
2	As datasets grow and analytic algorithms become more complex, the typical workflow of analysts launching an analytic, waiting for it to complete, inspecting the results, and then re-launching the computation with adjusted parameters is not realistic for many real-world tasks. This paper presents an alternative workflow, progressive visual analytics, which enables an analyst to inspect partial results of an algorithm as they become available and interact with the algorithm to prioritize subspaces of interest. Progressive visual analytics depends on adapting analytical algorithms to produce meaningful partial results and enable analyst intervention without sacrificing computational speed. As datasets grow and analytic algorithms become more complex, the typical workflow of analysts launching an analytic,waiting for it to complete, inspecting the results, and then re-launching the computation with adjusted parameters is not realistic for many real-world tasks. Progressive visual analytics depends on adapting analytical algorithms to produce meaningful partial results and enable analyst intervention without sacrificing computational speed. Download any data sets from UCI Machine Learning Repositories or Kaggle. Perform Exploratory data analytics that include: Study of data through pairplots, heatmaps, histograms, finding correlations amongst data, and so on
3	MapReduce is a kind of processing large scale data sets distributed Google proposed parallel programming model, also is Isthe current cloud computing core calculation model. Many scientific research institutions and companies are R & D design of a parallel processing system for massive data specification MapReduce based on their technology. Install R on a shared server and connect to Hadoop. Demonstrate execution of R programming constructs inside MapReduce using RMR2. Hence, develop any application using R and Hadoop Streaming by choosing data sets from Internet-bound big data repositories
4	PIPELINE.In machine learning, it is common to run a sequence of algorithms to process and learn from data. E.g., a simple text document processing workflow might include several stages: • Split each document's text into words. • Convert each document's words into a numerical feature vector. • Learn a prediction model using the feature vectors and labels. A Pipeline is specified as a sequence of stages, and each stage is either a Transformer or an Estimator. These stages are run in order, and the input DataFrame is transformed as it passes through each stage. Perform Machine Learning Clustering Task using SparkML in Python by choosing public datasets that are openly available for the task identified. Then, perform experiments and interpret the results obtained
5	Use Map Reduce framework to perform big data analytics on distributed clusters. by choosing public datasets that are openly available for the task identified.

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

<table>
<tr><td>Course Title</td><td colspan="4">Wireless and Mobile Networks</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS222</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT -1

Introduction: Fundamentals of wireless communication: Wireless communication system, Wireless media, Frequency spectrum, Wireless communication channel specifications, Types of wireless communication systems.

Basics of wireless networks: Wireless network architecture, Wireless network reference model, Wireless networking issues.

UNIT -2

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

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

UNIT -3

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

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

UNIT -4

Wireless Application protocol: Version 1.X Architecture, WAP 2.0.

4G LTE Networks: Introduction, LTE, LTE Architecture, Protocol layer Architecture, LTE Advanced, 5G Networks overview.

SELF-LEARNING COMPONENTS:

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

TEXT BOOKS:

1. Sunil Kumar S.Manvi, MahabaleshwarS.Kakkasageri, “Wireless and mobile networks concepts and protocols”, Wiley,2016.
2. Jochen3. Schillier, “Mobile Communications”, Pearson publishers,2004.

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

1. IEEE Transactions on Vehicular Technology
2. 3. IEEE Transactions on Wireless Communications
3. 4. Springer Wireless Networks Journal
4. Elsevier Journal of Wireless and Mobile Networks
5. IEEE Transactions on Wireless and Mobile Networks
6. Springer Jounal of Wireless and Mobile Networks

SWAYAM/NPTEL/MOOCs:

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

PRACTICE:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">User Interface (UI)/User Experience (UX) Design</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS223</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT- 1

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

UNIT -2

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

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

UNIT- 3

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

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

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

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

UNIT- 4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs," Designing the User Interface", 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/

Practice:

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

	up their food analogous to the self-check-out at some supermarkets, but even more extreme. Discuss how you would conduct a co11textual inquiry for a system that does not yet exist.
8	An airline company is designing a new online reservation system. They want to add some direct-manipulation features. For example, they would like customers to click a map to specify the departure cities and the destinations, and to click on the calendar to indicate their schedules. From your point of view, list four benefits and four problems of the new idea compared with their old system, which required the customer to do the job by typing text.
9	A company is designing a kiosk that can display weather information in public locations. The kiosk will feature a touch screen so users can select a city by pointing on a map. Give three reasons why a touch screen is an effective device for this application.
10	Your documentation team has developed an online help support for instant messaging client. You are hiring a usability testing firm to evaluate the online help and recommend improvements. Prepare a contract that specifies how you want the usability test to be performed and what reports you would like to receive. Your schedule gives them one week to prepare the study, one week to run it, plus one week to write up the final report. In your contract, specify the details of your requirements, including such information as the number of subjects required, test plans, and the types of reports.

SELF LEARNING:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">Unix System Programming</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS231</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

This course is an introduction to basic concepts of various fields of UNIX operating system is called the kernel . The kernel denes the application programming interface and provides all of UNIX's services, whether directly or indirectly. The kernel is a program, or a collection of interacting programs, depending on the particular implementation of UNIX, with many entry ointsp15 .

COURSE OBJECTIVES:

Objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

UNIX and ANSI Standards: ANSI C standard, ANSI/ISO C++ standards, Difference between ANSICandC++,POSIXstandards,POSIX.1FIPSstandard,X/Openstandards.UNIXandPOSIX APIs:POSIXAPIs,UnixandPOSIXdevelopmentEnvironment,APIcommoncharacteristics

Files: File types, Unix and POSIX file system, Unix and POSIX file attributes, INODES in Unix SystemV,Applicationprograminterfacetofiles,Unixkernelsupportforfiles,Relationshipof Cstreampointersandfiledescriptors,DirectoryFiles,HardandSymboliclinks.

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

UNIT- 2

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

Process Control: Introduction, Process identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 functions, Raceconditions, execfunctions, changing UsersIDs and GroupIDs, Interpreterfiles, Systemfunction, Process accounting, User identification, Process times, I/O Redirection.

Process Relationship: Introduction, Terminallogin, Networklogin, process groups, sessions,job control, Shell execution of programs, Orphaned processgroups.

UNIT -3

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

Daemon processes: Introduction, Daemon characteristics, Coding Rules, Error logging, Client server mod

UNIT-4

Inter Process Communication: Overview of IPCmethods, Pipes, Popen, Pclosefunctions, Co- processes, FIFOs system V IPC, Message Queues, Semaphores, Shared Memory, Client server properties, Streampipes, Passing Filede scriptors, Anopenserverversion1 and Clientserver connections functions.

SELF LEARNING COMPONENT

OPENMP, OPENMPI, Sockets

TEXT BOOKS:

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

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

SWAYAM/NPTEL/MOOCs:

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

Practice:

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

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

Course Title	Mobile Application Development				Course Type		Integrated	
Course Code	M20TCS232	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	0	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

Activity, Service, BroadcastReceiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API.

UNIT-4:

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Bill Phillips, Chris Stewart, and Kristin Marsican, "Android Programming" The Big Nerd Ranch Guide pearson technology group,3rd Edition,2015
2. Barry Burd, "Android Application Development All-in-One For Dummies", Wiley publisher, 2nd Edition, 2012.
3. ZigurdMednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming Android" Java Programming for the New Generation of Mobile Devices, oiley,2nd Edition,2012.

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

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

	track the Child's location as well as call logs, messages and contact from their smartphone. Reason for choosing android OS is that to target more users.
7	ANDROID DABBAWALA PROJECT This system is made with the view point of managing the Mumbai Dabbawala's who provide homemade food to the respective people working in an organization. With the help of this system the dabbawala can deliver the food at correct time. This system is developed in android where user can easily order their food with their hand held devices. As this system is developed in android user can easily use dabba service anywhere at anytime. This application is built to be beneficial to student knowledge as well as help Mumbai dabbawala's. This system allows the user to order the dabba service based on weekly, monthly or quarterly basis. System will calculate the cost based on the service user had selected. In this system android user can select dabba service or catering service. In dabba service he can get food delivered from his home by the dabbawala's at specified timing. In catering service he can order thali by mentioning certain details required for the dabbawala's such as food type, quantity, time etc. User can view the orders he had placed. User can make payment online by mentioning the details required for the payment. Admin can view order of various users. Admin can make dabba order as well as catering order in case user had informed through call. Admin can even view various user details. This system helps to manage the whole dabbawala system. This system helps to deliver food faster and at right time to the respective users.
8	ANDROID VOTING SYSTEM PROJECT This application provides is a new technique of casting votes using mobile phones. Android voting system is an application developed for android devices to deploy an easy and flexible way of casting votes anytime and from anywhere. The application is especially developed for organizations to get employees votes for any new policy regulation or issues. The issues or arguments are fed into the system by the admin. Employees can then cast their vote as yes or no. One voter can only post one vote for an argument. Each and every vote casted is stored in the database for the respective argument. At the end of the voting process the system counts the total votes and generates a brief report of it to the admin. Thus the app helps the company to get proper feedback of the employees
9	ANDROID VOTING SYSTEM PROJECT This application provides is a new technique of casting votes using mobile phones. Android voting system is an application developed for android devices to deploy an easy and flexible way of casting votes anytime and from anywhere. The application is especially developed for organizations to get employees votes for any new policy regulation or issues. The issues or arguments are fed into the system by the admin. Employees can then cast their vote as yes or no. One voter can only post one vote for an argument. Each and every vote casted is stored in the database for the respective argument. At the end of the voting process the system counts the total votes and generates a brief report of it to the admin. Thus the app helps the company to get proper feedback of the employees
10	CLASSROOM AUTOMATION USING ANDROID APP PROJECT In this Classroom Automation project, we are using an android app by which the user can select the classroom or group multiple classrooms to announce script, with this system human effort and time is reduced. Announcement from control room is captured with mic and feeded into the amplified box, from that amplifier box sound signal is sent into relay switching box, from relay switching box sound is switched into the respective classroom based on user inputs from android app

<table>
<tr><td>Course Title</td><td colspan="4">Python for Data Analysis</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS233</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT- 1

Preliminaries: Why Python for Data Analysis?Essential Python Libraries.Python Language Basics, IPython and Jupyter Notebooks: The python interpreter, IPython basics, Python language basics

Built in Data Structures, functions and Files: Data srructures and sequences, Functions, Files and operating system

UNIT- 2

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

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

UNIT- 3

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

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

UNIT- 4

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

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

SELF-LEARNING:

Advanced Numpy, Advanced Pandas, Data Aggregation

TEXT BOOKS:

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

REFERENCE BOOKS:

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

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">High Performance Computing</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS241</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of the course are:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

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

UNIT -2

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

UNIT-3

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

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

UNIT-4

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

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Chapman and Hall, “Introduction to High Performance Computing for Scientists and Engineers”, CRC Press,2011.

REFERENCE BOOKS:

1. Georg Hager, Gerhard Wellein, Rohit Chandra, Leo Dagum, DrorMaydan, David Kohr, Jeff McDonald, Ramesh Menon. “Parallel Programming in OpenMP”, Morgan Kaufmann Publisher, 2000
2. Shameem Akhter and Jason Roberts 6, “Multi-core programming, Increase performance through software multi Threading”, IEEE Transactions on Knowledge and Data Engineering, 2001
3. Kai Hwang , “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill, 1993
4. George S. Almasi and Alan Gottlieb , “Highly Parallel Computing”, Benjamin/Cummings Publisher, 1994

5. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, “Introduction to Parallel Computing”, Addison-Welsey, © 2003.

JOURNALS/MAGAZINES:

1. Springer Journal on High Performance Computing
2. Springer Journal on High Performance Computing
3. Elsevier Journal on High Performance Computing

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

SL.NO	List of Programs
1	Program which is composed of three parts executed consecutively: 1. A part which you can not parallelize, responsible for a fraction $\alpha 1 = 0.01$ of the total running time. 2. A part which you can parallelize with only 2 processors. This part is responsible for $\alpha 2 = 0.04$ of the time. 3. A part that can be parallelizable with many processors, occupying the remaining time of the program execution. According to the above information, what maximum speedup can you achieve, if you had no limitations on the number of processors n? How many processors do you need to obtain a speedup of at least 8?
2	Determine the asymptotic bounds on the operational intensity I(n) for the following matrix/vector operations, where n is the dimension of the vector. State your assumptions. 1. DAXPY: $y = \alpha x + y$ $\alpha \in R$; $x, y \in R^n$, double precision, 2. SGEMV: $y = Ax + y$ $x, y \in R^n$; $A \in R^{n \times n}$, single precision, 3. DGEMM: $C = AB + C$ $A, B, C \in R^{n \times n}$, double precision. Hint: Assume that A, B and C fit into the cache at the same time
3	Write a program that calculates the sum of numbers from 1 to 1000 in a parallel fashion while executing on all the cluster nodes and providing the result at the end on only one node. It should be noted that the print statement for the sum is only executed on the node that is ranked zero (0) otherwise the statement would be printed as much time as the number of nodes in the cluster.
4	Write an MPI code where array on each process is created. initialize it on process 0. Once the array has been initialized on process 0, then send it out to each process.
5	Implement and demonstrate the sharing of work among threads in an OpenMP program. using 'Sections Construct'
6	Non-blocking point-to-point operation allows overlapping of communication and computation to use the common parallelism in modern computer systems more efficiently. This enables the user to use the CPU even during ongoing message transmissions at the network level. Demonstrate the understanding of MPI Non-Blocking operation.
7	Sequential simulations frequently use a single random number generator. What must a parallel simulation do in this context? Some desirable properties are: 1. Each worker process must draw from a distinct random number sequence. 2. Repeatability between parallel runs when using the same random seed. 3. Repeatability in comparing a parallel run with n slaves and a parallel run with only 1 slaves, when using the same random seed. 4. Repeatability between the parallelized simulation and the original (unmodified) sequential simulation.
8	For this exercise study basic MPI functions such as: For MPI management MPI_Int(),MPI Final()

	Each MPI program should start with MPI_Int and finish with MPI_Final() Each process can fetch the number of processes in the default communicator MPI_COMM_WORLD (the application) by calling MPI_Comm_size Process in a MPI application are identified by so called ranks ranging from 0 to n-1 where n is the number of processs returned by MPI_Comm_size(). Based on the rank each process can perform a part of all required computations so that all process contribute to final goal and process all required data.
9	For Point-to-point communication: MPI-Send(), MPI_Recv() Int MPI_Send(void * buf, int count,MPI_Datatype dtype, int dest, int tag, MPI_Count(comm) MPI_Send sends data pointed by buf to process with with rank dest. There should be count elements of data type dtype. For instance, when sending 5 doubles, count should be 5 and dtype should be MPI_DOUBLE tag can be any number which additionally describe thwe message and comm. Can be MPI_COMM-WORLD for the default communications. Int MPI_ Recv(void *buf , int count, MPI_Datatype dtype Int src, int tag, MPI_Comm comm., MPI-Status *star) MPI-Recv is a blocking receive which waits for message with tag from process with rank src in communicator comm.. Dtype and count denote the type and the number of elements which are to be received and stored in buf. Stat holds information about the received message.
10	For collective communication MPI_Barrier (), MPI_Gather(), MPI_Scatter(),MPI_Allgather() As an example : Int MPI_Reduce(void *sbuf, void * rbuf, int count MPI_Datatype dtype, MPI_Op op, int root MPI_Comm comm) Reduce all values given by processes in communicator comm to a single value in process with rank root. See the code below for adding numbers given by all process to a single value in process 0

Course Title	Program Analysis				Course Type		Integrated	
Course Code	M20TCS242	Credits	4		Class		II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester		Assessment in Weightage	
	Theory	3	3	3				
	Practice	1	2	2	Theory	Practical	CIE	SEE
	-	**0**	-	-				
	Total	**4**	**5**	**5**	**39**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objective of this course is to:

1. Explain the basic concepts of data flow analysis through a contemporary optimization.
2. Describe common properties of program analysis at an abstract level.
3. Discuss the Complexity of Iterative Data Flow Analysis.
4. Illustrate the Data Flow Analysis in GCC

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT 4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Uday P. Khedker, 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/

PRACTICE:

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

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

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

<table>
<tr><td>Course Title</td><td colspan="4">Blockchain Technology</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS243</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">II Semester</td></tr>
<tr><td rowspan="5">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objective of the course is to:

1. Explain the underlying technology of transactions, blocks, proof-of-work, and consensus building
2. Discuss Hyperledger to build applications on blockchain
3. Describe the architecture of bit coins and to give the working of the bit coin
4. Illustrate the design and implementation of new ways of using blockchain technology

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

Use case I: Blockchain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance; Use case II: Blockchain in trade supply chain: Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc Use case III: Blockchain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system, social welfare systems.

UNIT-4

Blockchain Cryptography, Privacy and Security on Blockchain; Research aspects I: Scalability of Blockchain consensus protocols, Case Study of various recent works on scalability; Research aspects II: Secure cryptographic protocols on Blockchain; Case Study of Secured Multi-party Computation, Blockchain for science: making better use of the data-mining network; Case Studies: Comparing Ecosystems - Bitcoin, Hyperledger, Ethereum and more.

SELF-LEARNING COMPONENT:

Explore the architecture and design of Ethereum

TEXT BOOKS:

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

REFERENCE BOOKS:

1. "Hyperledger Fabric" - https://www.hyperledger.org/projects/fabric
2. Bob Dill, David Smits ,"Zero to Blockchain", An IBM Redbooks course, 2000

JOURNALS/MAGAZINES:

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

SWAYAM/NPTEL/MOOCS:

1. https://onlinecourses.nptel.ac.in/ Blockchain Technology
2. https://www.classcentral.com/course/ Blockchain Technology
3. https://nptel.ac.in/courses/106/266/106106156/
4. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
5. http://cs251crypto.stanford.edu/18au-cs251/syllabus.html

PRACTICE:

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

Course Title	Robotic Process Automation				Course Type	Theory	
Course Code	M20TCS251	Credits	3		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	0	-	-	Practical		
	Total	3	3	3	39	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. he objectives of this course are to

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENT:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT-4

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

SELF-LEARNING COMPONENTS:

Handling User Events and Assistant Bots

TEXT BOOKS:

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

SWAYAM/NPTEL/MOOCS:

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

Course Title	Agile software development				Course Type	Theory	
Course Code	M20TCS252	Credits	3		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objective of this course is to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

Motivation: The Facts of Change on Software Projects, Key Motivations for Iterative Development, Meeting the Requirements Challenge Iteratively, Problems with the Waterfall.

Evidence: Research Evidence, Early Historical Project Evidence, Standards-Body Evidence, Expert and Thought Leader Evidence, Business Case for Iterative Development.

UNIT 4

Fundamentals: Beginning DevOps for Developers, Introducing DevOps, Building Blocks of DevOps.

Metrics and Measurement View: Quality and Testing, Process view.

Technical View: Automatic Releasing, Infrastructure as Code, Specification by Example

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

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

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

Course Title	Deep Learning				Course Type	Theory	
Course Code	M20TCS253	Credits	3		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	3	3	3			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**3**	**3**	**3**	**39**	**50**	**50**

COURSE OVERVIEW:

This course introduces to 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.	1,2,3,4,5	1,2,3
CO2	Make use of suitable machine learning algorithms on real world problems (classification, clustering).	1,2,3,4,5,8	1,2,3
CO3	Utilize deep learning neural network model on real time applications like(face recognition, speech recognition)	1,2,3,4,5,8	1,2,3
C04	Apply object detection and recognition techniques to solve real world problems.	1,2,3,4,5	1,2,3

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT-4

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

SELF-LEARNING COMPONENT:

Linear factor Models, Structured probabilistic Models, Monte-Carlo Methods, Deep 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
2. https://www.classcentral.com/course/ Deep Learning
3. https://nptel.ac.in/courses/106/266/106106156/

Course Title	Cyber Security Lab				Course Type	Practice	
Course Code	M20TC0206	Credits	2		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**2**	4	4	**26**	**50**	**50**

COURSE OUTCOMES:

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

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

Practice:

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

COURSE ARTICULATION MATRIX

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

Course Title	Mini Project				Course Type	Practice	
Course Code	M20TC0207	Credits	2		Class	II Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	2	4	4	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**2**	**4**	**4**	**26**	**50**	**50**

COURSE OVERVIEW:

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

COURSE OBJECTIVE (S):

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

COURSE OUTCOMES (CO'S):

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

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

CO#/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1							3	3	3	3	3	3	3	3
CO2							3	3	3	3	3	3	3	3
CO3							3	3	3	3	3	3	3	3
CO4							3	3	3	3	3	3	3	3
CO5							3	3	3	3	3	3	3	3
CO6							3	3	3	3	3	3	3	3
CO7							3	3	3	3	3	3	3	3
CO8							3	3	3	3	3	3	3	3
CO9							3	3	3	3	3	3	3	3
CO10							3	3	3	3	3	3	3	3
CO11							3	3	3	3	3	3	3	3

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

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

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

COURSE CONTENTS

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

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

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

SAMPLE MINI PROJECTS:

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

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

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

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

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

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

II Year

Detailed Syllabus

III Semester
Syllabus

<table>
<tr><td>Course Title</td><td colspan="4">Virtual and Augmented Reality</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS311</td><td>Credits</td><td colspan="2">4</td><td colspan="2">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 colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to

1. Explain the principles and multidisciplinary features of virtual reality.
2. Illustrate the technology for multimodal user interaction and perception in VR, in particular the visual, audial and haptic interface and behavior.
3. Describe the objects using technology for managing large scale VR environment in real time.
4. Demonstrate the design of the solutions using VR system framework and development tools.

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS: **UNIT- 1**

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

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

UNIT -2

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

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

UNIT- 3

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

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

UNIT- 4

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

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

SELF-LEARNING COMPONENT:

Unity 3D, Manus VR

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Sherman, William R. and Alan B. Craig, “Understanding Virtual Reality – Interface,Application, and Design”, Morgan Kaufmann, 2002.
2. Fei GAO, “Design and Development of Virtual Reality Application System”, TsinghuaPress, March 2012.
3. Guangran LIU, “Virtual Reality Technology”, Tsinghua Press, Jan. 2011.

JOURNALS/MAGAZINES:

1. Springer Journal on Virtual and Augmented Reality
2. Springer Journal on Virtual and Augmented Reality
3. Elsevier Journal on Virtual and Augmented Reality
4. International Journal of Virtual and Augmented Reality (IJVAR).
5. Springer, Virtual Reality.

SWAYAM/NPTEL/MOOCS:

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

PRACTICE:

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

<table>
<tr><td>Course Title</td><td colspan="4">Computer Vision</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS312</td><td>Credits</td><td colspan="2">4</td><td colspan="2">Class</td><td colspan="2">III Semester</td></tr>
<tr><td rowspan="6">Course Structure</td><td>TLP</td><td>Credits</td><td>Contact Hours</td><td>Work Load</td><td colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
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<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain the fundamentals of Computer vision
2. Describe different segmentation techniques
3. Illustrate registration and classification of images.
4. Discuss the concepts of object detection in real world problem

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE Contents:

UNIT-1

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

UNIT-2

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

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

UNIT-3

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

UNIT-4

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

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach", Pearson, 2012.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer,2010

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

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

PRACTICE:

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

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

<table>
<tr><td>Course Title</td><td colspan="4">Natural Language Processing</td><td colspan="2">Course Type</td><td colspan="2">Integrated</td></tr>
<tr><td>Course Code</td><td>M20TCS313</td><td>Credits</td><td colspan="2">4</td><td colspan="2">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 colspan="2" rowspan="2">Total Number of ClassesPer Semester</td><td colspan="2" rowspan="2">Assessment in Weightage</td></tr>
<tr><td>Theory</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Practice</td><td>1</td><td>2</td><td>2</td><td rowspan="2">Theory</td><td rowspan="2">Practical</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td></tr>
<tr><td>-</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>4</td><td>5</td><td>5</td><td>39</td><td>26</td><td>50</td><td>50</td></tr>
</table>

COURSE OVERVIEW:

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

COURSE OBJECTIVES:

The objectives of this course are to:

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

COURSE OUTCOMES:

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

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

BLOOM'S LEVELOF THECOURSE OUTCOMES

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

COURSE ARTICULATIONMATRIX

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

COURSE CONTENTS:

UNIT-1

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

UNIT-2

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

UNIT-3

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

UNIT-4

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

SELF-LEARNING COMPONENT:

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

TEXT BOOKS:

1. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, OReilly Media, 2009.
2. Yuxi (Hayden) Liu, “Python Machine Learning by Example”, Packt publisher, 2017.

REFERENCES:

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

JOURNALS/MAGAZINES:

1. Springer Journal on Natural Language Process
2. Springer Journal on Natural Language Process
3. Elsevier Journal on Natural Language Process
4. ACM Transactions on Language Processing
5. Elsevier Journal of cognitive systems research

SWAYAM/NPTEL/MOOCS:

4. https://onlinecourses.nptel.ac.in/ Natural Language Process
5. https://www.classcentral.com/course/ Natural Language Process
6. https://nptel.ac.in/courses/476/876/3323106156/

PRACTICE:

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

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

Course Title	Open Elective				Course Type	Theory	
Course Code	M20TC0302	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	4	4	4			
	Practice	0	0	0	Theory	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**4**	**4**	**52**	**50**	**50**

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

Course Title	Project Work Phase – I				Course Type	Practice	
Course Code	M20TC0303	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	4	4	4	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**4**	**4**	**52**	**50**	**50**

COURSE OVERVIEW

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

COURSE OBJECTIVE (S):

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

COURSE OUTCOMES (CO'S):

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

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

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

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

CO11		√		√		

COURSE ARTICULATION MATRIX

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

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

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

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

- Review 1 shall be on the presentation of the synopsis and justification of the title and feasibility of the project
- Review 2 shall be on the presentation on the literature survey carried out.

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

Course Title	Internship/Global Certification				Course Type	Practice	
Course Code	M20TC0304	Credits	4		Class	III Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	o			
	Practice	4	0	0	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**4**	**4**	**4**	**52**	**50**	**50**

Internship

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	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).

Global Certification

COURSE OVERVIEW

The Global Certification is a one semester intensive project based learning approach to cater with the Industry requirement. It prepares the students to up skill their knowledge base to compete in terms of latest technology and become competent enough to the industry requirment. In this, students will be able to solve complex real world problems pertaining to the

domain chosen and gain confidence. It is an individual course and students have to earn the certificate based on their performances in terms of project assignment and aptitude. Student have to choose two Global certification courses.

COURSE OBJECTIVE (S):

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

COURSE OUTCOMES (CO'S):

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

CO#	Course Outcomes	POs	PSOs
CO1	Demonstrate in-depth knowledge on the project topic	1	1,2,3
CO2	Identify, analyze and formulate complex problem chosen for project work to attain substantiated conclusions.	2	1,2,3
CO3	Design solutions to the chosen project problem.	3	1,2,3
CO4	Undertake investigation of project problem to provide valid conclusions.	4	1,2,3
CO5	Use the appropriate techniques, resources, and modern engineering tools necessary for project work.	5	1,2,3
CO6	Apply project results for sustainable development of the society.	6	1,2,3
CO7	Understand the impact of project results in the context of environmental sustainability.	7	1,2,3
CO8	Understand professional and ethical responsibilities while executing the project work.	8	1,2,3
CO9	Function effectively as individual and a member in the project team.	9	1,2,3
CO10	Develop communication skills, both oral and written for preparing and presenting project report.	10	1,2,3
CO11	Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.	11	1,2,3

BLOOM'S LEVEL OF THE COURSE OUTCOMES

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

COURSE ARTICULATION MATRIX

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

CO10										3		3	3	3
CO11											3	3	3	3

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

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

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

IV Semester
Syllabus

Course Title	Project Work Phase – 2 and Dissertation				Course Type	Practice	
Course Code	M20TC0401	Credits	12		Class	IV Semester	
Course Structure	TLP	Credits	Contact Hours	Work Load	Total Number of ClassesPer Semester	Assessment in Weightage	
	Theory	0	0	0			
	Practice	12	12	12	Practice	CIE	SEE
	-	**0**	-	-			
	Total	**12**	**12**	**12**	**208**	**50**	**50**

COURSE OVERVIEW

Project Phase-2 is continuation of Project Phase-1 from semester 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	PSO1	PSO2	PSO3
CO1	3											3	3	3
CO2		3										3	3	3
CO3			3									3	3	3
CO4				3								3	3	3
CO5					3							3	3	3
C06						3						3	3	3
CO7							3					3	3	3
CO8								3				3	3	3
CO9									3			3	3	3
CO10										3		3	3	3
CO11											3	3	3	3

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

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

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

CAREER DEVELOPMENT AND PLACEMENT

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

WILLINGNESS TO LEARN

SELF MOTIVATION

TEAM WORK

COMMUNICATION SKILLS AND APPLICATION OF THESE SKILLS TO REAL SCENARIOS

REQUIREMENT OF GATHERING, DESIGN AND ANALYSIS, DEVELOPMENT AND TESTING SKILLS

ANALYTICAL AND TECHNICAL SKILLS

COMPUTER SKILLS

INTERNET SEARCHING SKILLS

INFORMATION CONSOLIDATION AND PRESENTATION SKILLS

ROLE PLAY

GROUP DISCUSSION, and so on

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

The need of the hour in the field of Commerce is efficient leaders of repute, who can deal the real time problems with a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, leadership, and strategic management and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career.

The University has recognized skill development and industry relationship as its very important activities. Therefore, the University-Industry Interaction and Skill Development Centre headed by a Senior Professor &Director has been established to facilitate skill related training to REVA students and other unemployed students around REVA campus. The center conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under PradhanMantriKaushalVikasYojana.

The various skill/certification programs identified are as follows:

Big-data and Cloud Computing, Internet of Things (IOT), ORACLE, MYSQL, Advanced Java and Internals of LINUX/UNIX

Red-hat certified programs on LINUX,

Management related programs like SAP, ERP and Business Analytics

Open Source software/hardware, Software Testing

Advanced networking based CISCO / Microsoft technology.

Web designing, System administration

IBM certified programs.

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

10 YEARS OF UNIVERSITY RECOGNITION

20 YEARS OF ACADEMIC EXCELLENCE

REVA UNIVERSITY

Bengaluru, India

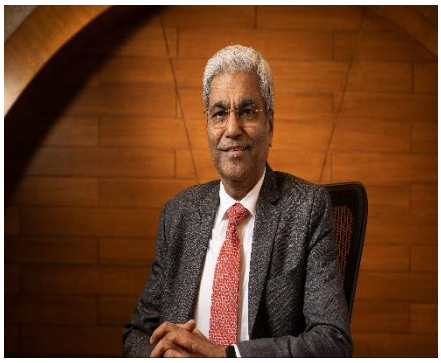
SCHOOL OF APPLIED SCIENCES

M.Sc. – MICROBIAL TECHNOLOGY

HANDBOOK: 2021-23

Rukmini Educational
Charitable Trust

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-centred and transformational approach. The excellent infrastructure at the University, both educational and extra-curricular, magnificently demonstrates the importance of ambience in facilitating focused learning for our students.

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

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

Vice-Chancellor's Message

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

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

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

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO,

AICTE and industries. The outcome of the research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

REVA University has entered into collaboration with many prominent industries to bridge the gap between industry and University. Regular visits to industries and mandatory internship with industries have helped our students. 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 Centres" in the University extend full support to the budding entrepreneurs to nurture their ideas and establish an enterprise.

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

Welcome to the portals of REVA University!

Dr. M. Dhanamjaya

Vice Chancellor

Director Message

Microbial Technology as interdisciplinary subject assimilates in itself a number of disciplines and as such has grown rapidly. M Sc in Microbial Technology offered by REVA University aims to provide the required skills and knowledge necessary to pursue a successful career in Microbiology. This program imparts need based, practical education in contemporary world to develop global competence among students. It strives to prepare students to become leaders in the field of Life Sciences in general and Microbiology in particular by encouraging them to inculcate scientific thinking coupled with creative and innovative ideas.

MSc Microbial Technology provides the specialization of three major domains of microbiology such as Industrial & Food Microbiology, Agriculture & Environmental Microbiology and Medical & Diagnostic Microbiology based on the interest of the students in collaboration with the industry partners. Maximum number of courses are integrated with cross cutting issues, relevance to professional ethics, gender, human values, environment and sustainability. The curriculum caters to and has relevance to local, national, regional and global developmental needs. The program provides hands-on and industry based training and practical skills in the specialised field of Microbiology and basics of Molecular genetics, Bioinformatics, Biochemical techniques & Enzymology, Environmental Microbiology, Molecular biology and Applied Microbiology aligning to current demand in the field of research & industry.

As far as employment is concerned Microbiology has become one of the fast-growing sectors. Employment record shows that Microbiology has a great scope in future. Microbiologists can find careers with pharmaceutical companies, chemical, agricultural and allied companies. They can be employed in the areas of planning, production and management of bio-processing industries. There is a large-scale employment in research laboratories run by the government as well as the corporate sectors

This handbook provides you outline of regulations for master's degree, scheme of instruction, and detailed syllabus. I am sure the students choosing MSc Microbiology at REVA University will enjoy the curriculum, teaching and learning environment, the vast infrastructure and the experienced faculties with excellent involvement and guidance. We will strive to provide all needed comfort and congenial environment for their studies. I wish all students a pleasant stay at REVA and grand success in their career.

Prof. Shilpa B R

Deputy Director, SoAS

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RUKMINI EDUCATIONAL CHARITABLE TRUST

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

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

The Rukmini Educational Charitable Trust drives with the main aim to help students who are in pursuit of quality education for life. REVA is today a family of ten institutions providing education from PU to Post Graduation and Research leading to PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates supported by committed administrative and technical staff. Over 15,000+ 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, Counsellors and Placement Officers.

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

The University has collaborations with Industries, universities abroad, research institutions, corporate training organizations, and Government agencies such as Florida International University, Oklahoma State University, Western Connecticut University, University of Alabama, Huntsville, Oracle India Ltd, Texas Instruments, Nokia University Relations, EMC^2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitates students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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

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

REVA organises various cultural programs to promote culture, tradition, ethical and moral values to our students. During such cultural events the students are given opportunities to unfold their hidden talents and motivate them to contribute innovative ideas for the progress of the society. 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's every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

VISION

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

MISSION

- To create excellent infrastructure facilities and state-of-the-art laboratories and incubation centres
- 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 APPLIED SCIENCES

The School of Applied Sciences offers graduate and post graduate programs in Biotechnology, Biochemistry, Chemistry, Physics and Mathematics which are incredibly fascinating. It aims to attract talented youth and train them to acquire knowledge and skills useful to industrial sectors, research laboratories, and educational institutions. The School presently offers M.Sc. degree programs in Bio-Chemistry, Bio-Technology, Chemistry, Physics, Mathematics, Bioinformatics, Microbial Technology and B Sc with various combinations viz, Biotechnology, Microbiology, Biochemistry and Genetics, Medical Laboratory Technology, Physics, Chemistry, Mathematics, Statistics, Computer Science, Bioinformatics, Statistics & Computer Science, Microbiology, Chemistry and Genetics and also Post Graduate Diploma in Clinical Embryology and Artificial Reproductive Technology. The school also facilitates research leading to PhD in Biotechnology, Biochemistry, Physics, Chemistry, Mathematics and related areas of study.

The School of Applied Sciences is shouldered by well qualified, experienced and highly committed faculty. The state-of-the-art infrastructure digital classrooms, well equipped laboratories, conference rooms and the serene academic atmosphere at REVA University will enhance the transfer as well as creation of knowledge. The school provides an interactive, collaborative peer tutoring environment that encourages students to break down complex problems and develop strategies for finding solutions across a variety of situations and disciplines. The school aims to develop a learning community of critical thinkers who serves as

models of innovative problems solving in the university environment to enrich their academic and professional careers.

VISION

To nurture intellect, creativity, character, professionalism and research culture among students and impart contemporary knowledge in various branches of Chemical, Biological, Physical and Mathematical Sciences that are socially relevant and transform them to become global citizens with leadership qualities.

MISSION

1. To achieve excellence in studies and research through pedagogy and support interface between industry and academia
2. To create intellectual curiosity, academic excellence, and integrity through multidimensional exposure
3. To establish state of the art laboratories to support research and innovation and promote mastery of science.
4. To inculcate an ethical attitude and make students competitive to serve the society and nation.

BOS MEMBERS

Sl. No	Name, Designation &Affiliation	External/Internal member
1	**Prof. Shilpa B.R** Associate Professor, Deputy Director and Head of the Department, Department of Biotechnology, School of Applied Sciences, REVA University, Bengaluru, Karnataka, India.	Chairperson
2	**Dr. Mahesh M,** **Chief Executive Officer**,	Industry Member

	Azyme Biosciences Pvt. Ltd., Bengaluru, Karnataka, India	
3	**Dr. Basavaraj Girennavar** Chairman and Managing Director, Criyagen Agri & Biotech Pvt. Ltd., Bengaluru, Karnataka, India	Industry Member
4	**Dr. Latha P,** Chief Operating Officer, X-Cyton Pvt Ltd, Bengaluru, Karnataka, India	Industry Member
5	**Dr. Pannuru Padmavathi,** Managing Director, DR Biosciences LLP, Bengaluru, Karnataka, India	Industry Member
6	**Dr. Pasupuleti Visweswara Rao** Associate Professor & Research Coordinator Head of Unit-Non-Communicable Diseases Research Niche Areas, Head of Internationalization unit Department of Biomedical Sciences and Therapeutics Universiti Malaysia Sabah (Central University) Kota Kinabalu, Sabah, Malaysia	International and Alumni Member
7	**Dr. Mahesh Yandigeri,** Senior Scientist, Division of Genomic Resources, National Bureau of Agricultural Insect Resources (NBAIR), Hebbal, Bengaluru, Karnataka, India	Academic Member
8	**Dr. G.B. Manjunatha Reddy,** Scientist, ICAR - National Institute of Veterinary Epidemiology and Disease Informatics (ICAR – NIVEDI), Yelahanka, Bangalore, Karnataka, India	Academic Member
9	**Dr. R. Ramachandra** Assistant Professor Department of Biotechnology	Internal Member

	School of Applied Sciences REVA University, Bangalore, Karnataka, India	
10	**Dr. N. M. Guruprasad** Assistant Professor Department of Biotechnology School of Applied Sciences REVA University, Bangalore, Karnataka, India	Internal Member

M.Sc. Microbial Technology Program Overview

The Masters' program in **Microbial Technology is Industry Oriented Program**, majorly focused on the applied aspects of microbiology in various specialized areas of science and technology such as industry, agriculture and medicine. Microbial Technology emphasizes hands-on learning through laboratories sessions, internships, skill development programs conducted every semester.

The curriculum of the program is reviewed and approved esteemed members from reputed industries and research organization to makes is industry oriented in true sense. Students will have an opportunity to take up projects either at department or at reputed industries as well at state and central governments research organizations in the final semester. Well qualified faculty members with rich industry and research experience guide the students to excel in academics and research. Three different specializations have been offered for the program like Industrial and Food Microbiology, Plant and Agricultural Microbiology and Medical and Pharmaceutical Microbiology in collaboration with reputed industries like **Azyme Biosciences Pvt. Ltd., Criyagen Agri & Biotech Pvt. Ltd., DR BioSciences LLP., X-Cyton Pvt Ltd.,** to ensure right skill sets for students as per chosen specialization.

Curriculum is well designed with hardcore (HC) and softcore (SC) courses. MOOC/Swayam/ Coursera Online Courses, short term certification courses and workshops are offered to equip the students with skill sets required for employability and research. There are wide range of

career options for MSc Microbial Technology program in various domains of life sciences. The career opportunities include teaching, Scientist, Industries, Research Organizations, State and Central Universities, Agriculture Universities, Hospitals, Diagnostic laboratories, Nutritionist, Project Assistant, Research Assistant, Research Analyst, Clinical Research Associates, Teaching Assistant, Lecturer and Business start-ups. In this context, University Programmes at undergraduate and postgraduate level in Life Sciences across the country have become relevant.

M. Sc. Microbial Technology at REVA UNIVERSITY has been designed to meet the human resources needs of existing and futuristic Life Science industries, research organizations and academic institutions. The programme is designed to produce graduates with higher order critical, analytical, problem solving and research skills, ability to think rigorously and independently to meet higher level expectations of biotech industries, research organization and academic institutions. The programme also provides sufficient skills and training on entrepreneurship development in Life Sciences.

Program Educational Objectives (PEOs)

After few years of graduation, the graduates will:

PEO-1	Become a professional Microbiologist with academic excellence, ethics and communication skills and perform in a team.
PEO-2	Equip with necessary analytical and research skills to establish themselves as a competent scientist/microbiologist.
PEO-3	Become successful entrepreneurs with an ability to develop new products/processes with an attitude of lifelong learning.

Program Outcomes (POs)

After successful completion of program, the graduates will be able

1. **Master of Science Knowledge**-Apply the knowledge of microbiology and applied microbiology to the solution of complex biological problems.

2. **Problem analysis-** Identify, formulate, review research literature and analyse complex biological problems reaching substantiated conclusions using various principles of life science domain and microbiology.
3. **Design/development of solutions-**Design solutions for complex biological problems and design protocols or processes that meet the specified needs with appropriate consideration for the public health and safety, conservation of biodiversity, better understanding of the microorganisms and necessary tools for finding solutions of various crippling human/plant diseases with ethical, societal, and environmental considerations.
4. **Conduct investigations of complex problems-**Use the various protocols developed through extensive research-based knowledge and methods including design of experiments, analysis and interpretation of data, and provide valid and reproducible conclusions.
5. **Environment and sustainability**-Apply the classic and modern biological theoretical and practical knowledge gained to address societal, health, microbial and plant biodiversity studies, safety, ethical and cultural issues and the consequent responsibilities relevant to the professional upgradation of the student and society as a need for sustainable development.
6. **Ethics-**Apply ethical principles established by different government agencies and commit to research ethics, responsibilities and norms to undertake their current and future research and development.
7. **Individual and team work**-Be an independent thinker and researcher effectively as an individual, and as a member or leader of different teams, and in multidisciplinary research Institutions and Universities.
8. **Communication**-Communicate effectively on complex research activities with the scientific community and with society at large, as a scientist or a teacher, be well versed with scientific writing and write effective reports and design research projects, make effective presentations, and be able to defend it efficiently.
9. **Project management and finance**-Write good research and development projects relevant to the needs of society and environment and attract extra mural funds for himself and his team in the Institute or University from various funding agencies and manage R&D projects effectively.

10. **Life-long learning**-Apply the discipline, ethics and knowledge obtained to engage in independent and life-long learning in their respective fields of interest wherever they go for further higher studies or jobs.

Program Specific Outcomes (PSO)

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

1. Understand about environmental microbiology, food & diary Microbiology, Industrial Microbiology and many other technologies involved in microbiology industries and academic institutions.
2. Provide a strong foundation for a career working skills with project management, business development or venture capital within the microbiology, agriculture, food, environment, medical technology or related industries.
3. Utilise the skills to design, perform and analyse a research problem which has a social relevance and outcome with acquired skills of presentation and scientific writing.

REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Postgraduate Degree programs- 2021-22

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

1. Tie and Commencement:

1.1. These Regulations shall be called the **"REVA University Regulations for Choice Based Credit System (CBCS) and Continuous Assessment Grading Pattern (CAGP) for Post Graduate Degree Programs- 2021-22".**

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

2. The Programs:

The following programs and all Graduate Degree programs to be instituted and introduced in REVA University in coming years shall follow these regulations.

M.Sc. in:

Biotechnology

Biochemistry

Chemistry

Physics

Mathematics

Microbial Technology

Bioinformatics

3. Definitions:

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

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

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

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

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

4. Courses of study and Credits

4.1. The study of various subjects in M. Sc., degree program is grouped under various courses. Each of these course carries credits which are based on the number of hours of teaching and learning.

4.1.1. In terms of credits, every **one hour session of L amounts to 1 credit per Semester.**

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** over a period of one Semester of 16 weeks for teaching-learning process.

4.1.2. The total duration of a semester is 20 weeks inclusive of semester-end examination.

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

4.1.4. ***The concerned BoS will assign Credit Pattern for every course based on the requirement. However, generally, courses can be assigned with 1-4 Credits depending on the size of the course.***

4.1.5. Different **Courses of Study** are labelled and defined as follows:

Core Course:

A course which should compulsorily be studied by a candidate as a core-requirement is termed as a Core course. The CORE courses of Study are of THREE types, viz – (i) Hard Core Course, and (ii) Soft Core Course, (iii) Open Elective and (iv)Mandatory Courses

a. Hard Core Course (HC):

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

b. Soft Core Course (SC):

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

c. Open Elective Course:

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

d. Skill Enhancement Course:

It is a mandatory course to equip students with skill sets required as per the industry expectation. Candidate will seek exposure through workshops and other certificate-based courses.

e. Project Work / Dissertation:

Project work / Dissertation work is a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problem. A project work carrying **FOUR or SIX** credits is called **Minor Project** work / **Dissertation.** A project work of **EIGHT, TEN, TWELVE or SIXTEEN** credits is called **Major Project** work / **Dissertation**. **A Project work may be a hard core or a Soft Core as decided by the BoS / concerned.**

f. Mandatory Course (MC): The mandatory course is non credited but must be passed to complete the Graduate Degree Program

5. Eligibility for Admission:

Bachelors Degree of three years with Biotechnology or any Life Science subject as one of the cognate / major / optional subjects with 60% (40% in case of candidates belonging to SC/ST) of marks in aggregate from any recognized University / Institution or any other qualification recognized as equivalent thereto.

6. Scheme, Duration and Medium of Instructions:

6.1. M.Sc., degree program is of 4 semesters - 2 years duration. A candidate can avail a maximum of 6 semesters (3 years) including blank semesters, if any to successfully complete M.Sc. degree. Whenever a candidate opts for blank semester, he/she has to study the prevailing courses offered by the School when he/she resumes his/her studies.

6.2. The medium of instruction shall be English.

7. Credits and Credit Distribution

7.1. A candidate has to earn 90 credits for successful completion of Two-Year Postgraduate

degree with a distribution of credits for different courses as given in Table - 1 given below:

Table-1: Credits and Credit Distribution for Two Year Post Graduate degree program in Sciences

Course Type	Credits for Two Year (4 Semesters) Post Graduate Degree Programs
Hard Core Course	A minimum of 60 but not exceeding 70
Soft Core Course	A minimum of 10 but not exceeding 30
Open Elective	A minimum of 4
SEC	A minimum of 2
Project/Dissertation	A minimum of 10
MOOC / Swayam/ Coursera/Soft Skill Training	A minimum of 4
Total	**90**

7.2. The concerned BOS based on the credits distribution pattern given above shall prescribe the credits to various types of courses and shall assign title to every course including project work, practical work, field work, self-study elective, as **Hard Core (HC) or Soft Core (SC) Open Elective (OE)** and Mandatory course (MC).

7.3. Every course including project work, practical work, field work, self-study elective should be entitled as Hard Core (HC) or Soft Core (SC) or Open Elective (OE), Mandatory Course (MC) by the BoS concerned.

The BOS of respective program/ discipline shall decide about the total credits for the courses.

Sl. No.	Course Title	Number of Credits
1	MOOC / Swayam/ Coursera/Internship /Soft Skill Training	4
	Total	**4**

7.4. The concerned BOS shall specify the desired Program Objectives, Program Educational Objectives, Program Specific Outcomes and Course Outcomes while preparing the curriculum of a particular program.

7.5. A candidate can enrol for a maximum of 30 credits and a minimum of 20 credits per Semester. However, he / she may not successfully earn a maximum of 30 credits per semester. This maximum of 30 credits does not include the credits of courses carried forward by a candidate.

7.6. 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 90 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.

8. Add-on Proficiency Certification / Diploma:

8.1 Add- on Proficiency Certification:

To acquire Add on Proficiency Certification a candidate can opt to complete a minimum of 4 extra credits either in the same discipline /subject or in different discipline / subject in excess to 90 credits for the Two Year Post Graduate degree programs.

8.2 Add on Proficiency Diploma:

To acquire Add on Proficiency Diploma, a candidate can opt to complete a minimum of 18 extra credits either in the same discipline /subject or in different discipline / subject in excess to 90 credits for the Two Year Post Graduate degree programs.

The Add on Proficiency Certification / Diploma so issued to the candidate contains the courses studied and grades earned.

9. Assessment and Evaluation

a) Each course is assessed for a total weight of 100%. Out of the total 100% weight; 50% weight is for Continuous Internal Assessment (CIA or IA) and the remaining 50% for the Semester End Examination (SEE). This applicable for theory, laboratory, workshop, studio and any such courses

b) Out of 50% weight earmarked for Internal Assessment (IA)- 15% for test-1, 15% for test-2 and 20% for Assignments and this is applicable for theory based courses

c) The tests and assignments are conducted as per the semester academic calendar provided by the University

The details as given in the table

Component	Description	Conduction	Weight Percentage
C1	**Test-1: IA1**	**8th week from the starting date of semester**	**15**
	Test-2: IA2	**16th week from the starting date of semester**	**15**
C2	**1 Assignment**	**7th week**	**10**
	2 Assignment	**14th week**	**10**
C3	**SEE including practical**	**between 17th Week-20th Week**	**50**
Results to be Announced			**By the end of 21st Week**

Note: IA or CIA includes C1 and C2

Each test must be conducted for a duration of 60 minutes, setting the test question paper for a maximum of 30 marks. The final examination must be conducted for a duration of 3 hours and the question paper must be set for a maximum of 100 marks.

d) Students are required to complete courses like technical skills, placement related courses, Open electives and any such value addition or specialized courses through online platforms like SWAYAM/NPTEL/Any other reputed online education aggregator. Students are required to choose the courses on the advice of their course coordinator/Director and required to submit the course completion certificate along with percentage of marks/grade scored in the assessment conducted by the online education aggregator. If the online education aggregator has issued a certificate along with the grade or marks scored to students, such courses will be considered for SGPA calculations, in case the aggregator has issued only a

certificate and not marks scored, then such courses will be graded through an examination by concerned School, in case, if grading is not possible, students will be given a pass grade and award the credit and the credits will not be considered for SGPA calculations. The Online/MOOCs courses will not have continuous internal assessment component

Such of those students who would like to discontinue with the open elective course that they have already registered for earning required credits can do so, however, they need to complete the required credits by choosing an alternative open elective course.

Setting question paper and evaluation of answer scripts.

1. For SEE, three sets of question papers shall be set for each theory course out of which two sets will be by the internal examiners and one set will be by an external examiner. In subsequent years by carrying forward the unused question papers, an overall three sets of question papers should be managed and depending on the consumption of question papers either internal or external examiner be called for setting the question paper to maintain an overall tally of 3 papers with the conditioned mentioned earlier. The internal examiner who sets the question paper should have been course tutor.
2. The Chairman of BoE shall get the question papers set by internal and external examiners.
3. The Board of Examiners shall scrutinize and approve the question papers and scheme of valuation. It is the responsibility of the BoE to see that all questions contained in the question paper are within the prescribed syllabus of the concerned course.
4. There shall be single valuation for all theory papers by internal examiners. However, there shall be moderation by the external examiner who has the subject background. In case no external examiner with subject background is available, a senior faculty member within the discipline shall be appointed as moderator.
5. The SEE examination for Practical work / Field work / Project work/Internship will be conducted jointly by internal and external examiners as detailed below: However, the BoE on its discretion can also permit two internal examiners.
6. If a course is fully of (L=0):T:(P=0) type or a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

10. Evaluation of Practical's and Minor Project / Major Project / Dissertation

10.3.1. A practical examination shall be assessed on the basis of:

a) Knowledge of relevant processes;

b) Skills and operations involved;

c) Results / products including calculation and reporting.

10.3.2. In case a course is fully of P type (L=0:T=0:P=4), 2 credits, the performance of a candidate shall be assessed for a maximum of 100 marks as explained below:

a) Continuous Internal assessment (CIA) = 50 marks

b) Semester end practical examination (SEE) = 50 marks

The 50 marks for continuous assessment shall further be allocated as under (IA or CIA):

I	Conduction of regular practical throughout the semester	20 marks
Ii	Maintenance of lab records /industry reports/SDP reports	15 marks
iii	Laboratory test and viva	15 marks
	Total	50 marks

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

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

10.3.3. The SEE for Practical work will be conducted jointly by internal and external examiners. However, if external examiner does not turn up, then both the examiners will be internal examiners.

10.3.4. In case a course is partly P type i.e, (L=3): (T=0) (P=1), then the examination for SEE component will be as decided by the BoS concerned.

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

10.4. 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:

1	First Dissertation presentation describing the problem definition	Should be done a semester before the project semester	Weightage: 0%
2	Dissertation Progress presentation-1	7th week from the start date of project semester	Weightage: 25%
3	Dissertation progress presentation-2	14th Week from the start date of project semester	Weightage -25%
4	Final project Viva and Dissertation Submission	17th -20th Week of project Semester	Weightage: 30% for Dissertation Weightage: 20% for Final Viva Voce

11. Provision for Appeal

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

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

follows:-

- The Controller of Examination - 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.

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12. Eligibility to Appear Semester End Examination (SEE)

12.1. Only those students who fulfil a minimum of 75% attendance in aggregate of all the courses including practical courses / field visits etc, as part of the course(s), as provided in the succeeding sections, shall be eligible to appear for SEE examination.

12.2. Requirements to Pass a Course

Students are required to score a total minimum of 40% (Continuous Internal assessment and SEE) in each course offered by the University/ Department for a pass (other than online courses) with a minimum of 20 (40% of 50) marks in final examination

13. Requirements to Pass the Semester

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

13.1 Provision to Carry Forward the Failed Subjects / Courses:

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

13.2 Provision for Supplementary Examination

In case a candidate fails to secure a minimum of 25% (13 marks) in Semester End Examination (SEE) and a minimum of 40% marks together with IA and SEE to declare pass in the course, 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.

13.3. Provision to Withdraw Course:

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

13.4. Re-Registration and Re-Admission:

a) 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 end semester examination (C3) and he / she shall have to seek re-admission to that semester during subsequent semester / year within a stipulated period.

b) 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.

14. Attendance Requirement:

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

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

a) 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 (C4) examination and such student shall seek re-admission as provided in 7.8.4.

b) Teachers offering the courses will place the above details in the School Board meeting during the last week of the semester, before the commencement of C3, and subsequently a notification pertaining to the above will be brought out by the Director of the School before the commencement of C3 examination. A copy of this notification shall also be sent to the office of the Registrar & Controller of Examination.

15. Absence during Mid Semester Examination:

In case a student has been absent from a mid-semester (C1, C2) examination due to the illness or other contingencies he/she may give a request along with necessary supporting documents and certification from the concerned class teacher/authorized personnel to the concerned Head of the School, for make-up examination. The Head of the School may consider such request depending on the merit of the case and after consultation with course instructor and class teacher, and arrange to conduct a special test for such candidate(s) well in advance before the C3 examination of that respective semester. Under no circumstances C1, C2 test shall be held after C3 examination.

16. Grade Card and Grade Point

16.1. Provisional Grade Card: The tentative/provisional grade card will be issued by the Controller of Examination at the end of every semester indicating the courses completed successfully. The provisional grade card provides **Semester Grade Point Average** (SGPA).

16.2. Final Grade Card: Upon successful completion of M.Sc., Degree a Final Grade card consisting of grades of all courses successfully completed by the candidate will be issued by the Controller of Examination.

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

Marks P	**Grade** G	**Grade Point** (GP=V x G)	**Letter Grade**

90 -100	10	v*10	O
80 - 89	9	v*9	A+
70 - 79	8	v*8	A
60 - 69	7	v*7	B+
55 - 59	6	v*6	B
50 - 54	5.5	V*5.5	C +
40 - 49	5	v*5	P
0 - 39	0	v*0	F
ABSENT			AB

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

Here, P is the percentage of marks (P=[C1+C2+C3]) 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

16.3.1. 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 in a given semester, i.e:

SGPA (Si) = ∑(Ci x Gi) / ∑Ci where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith course.

Illustration for Computation of SGPA and CGPA

Illustration No. 1

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit x Grade)
Course 1	4	A+	9	4X9=36
Course 2	4	A	8	4X8=32

Course 3	3	B+	7	3X7=21
Course 4	3	O	10	3X10=30
Course 5	3	P	5	3X5=15
Course 6	3	B	6	3X6=18
Course 7	2	O	10	2X10=20
Course 8	2	A	8	2X8=16
	24			188

Thus, **SGPA = 188 ÷ 24 = 7.83**

Illustration No. 2

Course	**Credit**	**Grade letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	A	8	4X8=32
Course 2	4	B+	7	4X7=28
Course 3	3	A+	9	3X9=27
Course 4	3	B+	7	3X7=21
Course 5	3	B	6	3X6=18
Course 6	3	P	5	3X5=15
Course 7	2	B+	7	2X7=21
Course 8	2	O	10	2X10=20
	24			175

Thus, **SGPA = 175 ÷ 24 = 7.29**

Illustration No.3

Course	**Credit**	**Grade Letter**	**Grade Point**	**Credit Point (Credit x Grade point)**
Course 1	4	O	10	4 x 10 = 40
Course 2	4	A+	9	4 x 9 = 36

Course 3	3	B+	7	3 x 7 = 21
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	B+	7	3 x 7 = 21
Course 7	2	A+	9	2 x 9 = 18
Course 8	2	A+	9	2 x 9 = 18
	24			199

Thus**, SGPA = 199 ÷ 24 = 8.29**

Cumulative Grade Point Average (CGPA):

Overall Cumulative Grade Point Average (CGPA) of a candidate after successful completion of the required number of credits (96) for Two year Post Graduate degree program is calculated taking into account all the courses undergone by a student over all the semesters of a program i. e.,

$CGPA = \sum(Ci \times Si) / \sum Ci$

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: No.1

CGPA after Final Semester

Semester (ith)	**No. of Credits (Ci)**	**SGPA (Si)**	**Credits x SGPA (Ci X Si)**
1	24	6.83	24 x 6.83 = 163.92
2	26	7.71	26 x 7.71 = 200.46
3	26	8.68	26 x 8.68 = 225.68
4	14	9.20	14 x 9.20 = 128.8
Cumulative	90		718.86

Thus, CGPA = $\frac{24x6.83+26x7.71+26x8.68+14x9.20}{90} = \frac{718.86}{90} = 7.99$

16.3.2. 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 8.10 x 10=81.0

16.3.3. Classification of Results

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

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

Overall percentage=10*CGPA

17. Challenge Valuation

For all PG courses since it is a double valuation (Internal and External Examiners), candidate shall not have an option to apply for challenge valuation.

Mapping of PEOS with Respect to POs and PSOs

	PO1	P2	PO3	PO4	PO5	PO6	P7	PO8	PO9	PO 10	PSO 1	PSO 2	PSO 3
PEO1	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO2	√	√	√	√	√	√	√	√	√	√	√	√	√

PEO3	√	√	√	√	√	√	√	√	√	√	√	√	√

Mapping of Course Outcomes with programme Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0101	CO1	3	3	2	3			2	1		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	3
	CO3	3	2	2	2			2			3	3	2	3
	CO4	3	3	2	3	2	2	2	1		3	3	2	3
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0102	CO1	3	3	3	3			1	1	1	3	3	3	3
	CO2	3	3	3	2		1	1		1	3	3	2	2
	CO3	3	3	2	2			1		1	3	3	2	2
	CO4	3	3	2	2		2	2	1	1	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0103	CO1	3	3	3	3			1	1		3	3	3	3
	CO2	3	3	2	2	1	1	1			3	3	2	2
	CO3	3	3	2	2	1		1	2	2	3	3	2	2
	CO4	3	3	2	2	1	1	2	1	3	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS111	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS112	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS121	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2

	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS122	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3			2	2	2	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0104	CO1	3	3	3	3			2			3	3	3	3
	CO2	3	3	3	2			2			3	3	3	3
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	3	3			2			3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0105	CO1	3	3	3	3			2			3	3	3	3
	CO2	3	3	3	2			2			3	3	3	3
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	3	3			2			3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0106	CO1	3	3	3	3			2			3	3	3	3
	CO2	3	3	3	2			2			3	3	3	3
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	3	3			2			3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0201	CO1	3	3	3	2			2		2	3	3	3	2
	CO2	3	3	3	2			2		2	3	3	2	2
	CO3	3	3	2	2			2		2	3	3	2	2
	CO4	3	3	2	2			2		2	3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0202	CO1	3	3	3	3		3	3			3	3	2	2

	CO2	3	3	2	2		2	2			3	3	2	2
	CO3	3	3	2	2		2	2			3	3	2	2
	CO4	3	3	2	2		2	2			3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0203	CO1	3	3	2	3	2		2		1	3	3	3	2
	CO2	3	3	2	2	3		2		1	3	3	3	2
	CO3	3	3	2	2	3		2		1	3	3	3	2
	CO4	3	3	2	2	3		2		1	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS211	CO1	3	3	3	3		2	3		1	3	3	2	2
	CO2	3	2	2	2		2	3		1	3	3	2	2
	CO3	3	2	2	2			3		1	3	3	2	2
	CO4	3	3	2	2		2	2		1	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS212	CO1	3	3	3	3		2	3		1	3	3	2	2
	CO2	3	2	2	2		2	3		1	3	3	2	2
	CO3	3	2	2	2			3		1	3	3	2	2
	CO4	3	3	2	2		2	2		1	3	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0204	CO1	3	3	2	2	2	1	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	1	2	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0205	CO1	3	3	2	2	2	1	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	1	2	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3

M21SO0206	CO1	3	3	2	2	2	1	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	1	2	3	2	2
Course Code	**POS/ COs**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PS01	PS02	PS03
M21SL0301	CO1	2	3		3	2		3				3	3	2
	CO2	3	2									2	2	3
	CO3	3	2		3			3		3	3	3	3	2
	CO4	2	3	3	3			3				3	3	3
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ301	CO1	3	3	2	3	1	3	1	2	1	3	3	2	2
	CO2	3	2	2	3	1	3	1	2	1	2	3	2	2
	CO3	3	2	2	3		2	1	2	2	2	3	2	2
	CO4	3	3	2	3	1	2	2	2	1	2	3	2	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ302	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ303	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ304	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ305	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ306	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ307	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ308	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ309	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ310	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2

	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ311	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ312	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ313	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ314	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ315	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ316	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2

	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ317	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ318	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS311	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS312	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SLO301	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SLO302	CO1	3	3	3	2	1		2	2		3	3	3	2

	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0401	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOON01	CO1	2	2	3			3					1	1	3
	CO2	3	2									1	1	3
	CO3	3	3								3	1	1	3
	CO4	3	3								3	1	1	3
Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOON02	CO1	2	2	3			3					1	1	3
	CO2	3	2									1	1	3
	CO3	3	3								3	1	1	3
	CO4	3	3								3	1	1	3
Course Code	POS / COS	PO1	PO2	P O 3	PO4	PO5	P O 6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PS O3
M21SO0401	CO1	2	2	3			3					1	1	3
	CO2	3	2									1	1	3
	CO3	3	3								3	1	1	3
	CO4	3	3								3	1	1	3

REVA UNIVERSITY

School of Applied Sciences

Department of Biotechnology

MSc (Microbial Technology) Program

Scheme of Instruction (Effective from Academic Year 2021-22)

FIRST SEMESTER	**Course code**	**Course**	**HC/ SC/ OE**	**L**	**T**	**P**	**Credits**	**Hours/ Week**
1	**M21SO0101**	Microbiological methods	HC	4	0	0	4	4
2	**M21SO0102**	Molecular Microbial Genetics	HC	4	0	0	4	4
3	**M21SO0103**	Bioanalytical Techniques	HC	4	0	0	4	4
4	**M21SOS111**	Research Methodology	SC	4	0	0	4	4
5	**M21SOS112**	Entrepreneurship in Life Sciences						
6	**M21SOS121**	Cell Culture Technology	SC	4	0	0	4	4
7	**M21SOS122**	Microbial Metabolites						
	PRACTICAL SESSIONS							
8	**M21SO0104**	Microbiological Methods LAB	HC	0	0	2	2	4
9	**M21SO0105**	Molecular Microbial Genetics LAB	HC	0	0	2	2	4
10	**M21SO0106**	Bioanalytical techniques Lab	HC	0	0	2	2	4
	Total Credits			**20**	**0**	**6**	**26**	**32**
SECOND			**HC/ SC/**	**L**	**T**	**P**	**Credits**	**Hours/**

SEMESTER			OE					Week
1	**M21SO0201**	Microbial Metabolism and Physiology	HC	4	0	0	4	4
2	**M21SO0202**	Microbial Diversity	HC	4	0	0	4	4
3	**M21SO0203**	Bioinformatics and Biostatistics	HC	4	0	0	4	4
4	**M21SOS211**	Microbiology for Sustainable Environment	SC	4	0	0	4	4
5	**M21SOS212**	Microbial Food Processing						
	PRACTICAL SESSIONS							
6	**M21SO0204**	Microbial metabolism and Physiology Lab	HC	0	0	2	2	4
7	**M21SO0205**	Microbial Diversity LAB	HC	0	0	2	2	4
8	**M21SO0206**	Bioinformatics and Biostatistics Lab	HC	0	0	2	2	4
9	**M21PTM201**	Soft Skill Training (Mandatory Course) offered by Training and Placement	MC	3	0	0	0	3
	Total Credits			**18**	**0**	**6**	**22**	**28**
THIRD SEMESTER			**HC/ SC/ OE**	**L**	**T**	**P**	**Credits**	**Hours/ Week**
	Specialization in Industrial & Food Microbiology							
1	**M21SOZ301**	Food Microbiology	HC	4	0	0	4	4
2	**M21SOZ302**	Bioprocess Technology	HC	4	0	0	4	4
3	**M21SOZ303**	Food Chemistry and Processing	HC	4	0	0	4	4
4	**M21SOS311**	Nano biotechnology and	SC	4	0	0	4	4

		Space Microbiology						
5	**M21SOS312**	Marine Microbiology						
	PRACTICAL SESSIONS							
6	**M21SOZ304**	Food Microbiology Lab	HC	0	0	2	2	4
7	**M21SOZ305**	Bioprocess Technology Lab	HC	0	0	2	2	4
8	**M21SOZ306**	Food Chemistry and Processing lab	HC	0	0	2	2	4
9	**M21SLO301**	Organic Farming	OE	4	0	0	4	4
10	**M21SL0302**	Skill Enhancement Course	HC	2	0	0	2	2
	Total Credits			**22**	**0**	**6**	**28**	**34**
	Specialization in Agriculture & Environmental Microbiology							
1	**M21SOZ307**	Soil Microbiology	HC	4	0	0	4	4
2	**M21SOZ308**	Plant Pathology	HC	4	0	0	4	4
3	**M21SOZ309**	Biomass and energy systems	HC	4	0	0	4	4
4	**M21SOS311**	Nano biotechnology and Space Microbiology	SC	4	0	0	4	4
5	**M21SOS312**	Marine Microbiology						
	PRACTICAL SESSIONS							
6	**M21SOZ310**	Soil Microbiology Lab	HC	0	0	2	2	4
7	**M21SOZ311**	Plant Pathology Lab	HC	0	0	2	2	4
8	**M21SOZ312**	Biomass and energy systems Lab	HC	0	0	2	2	4
9	**M21SLO301**	Organic Farming	OE	4	0	0	4	2
10	**M21SL0302**	Skill Enhancement Course	HC	2	0	0	2	2
	Total Credits			**22**	**0**	**6**	**28**	**30**
	Specialization in Medical and Pharmaceutical Microbiology							

1	**M21SOZ313**	Clinical Microbiology	HC	4	0	0	4	4
2	**M21SOZ314**	Medical Biochemistry	HC	4	0	0	4	4
3	**M21SOZ315**	Pharmaceutical Microbiology	HC	4	0	0	4	4
4	**M21SOS311**	Nanobiotechnology and Space Microbiology	SC	4	0	0	4	4
5	**M21SOS312**	Marine Microbiology						
	PRACTICAL SESSIONS							
6	**M21SOZ316**	Clinical Microbiology Lab	HC	0	0	2	2	4
7	**M21SOZ317**	Medical Biochemistry Lab	HC	0	0	2	2	4
8	**M21SOZ318**	Pharmaceutical Microbiology Lab	HC	0	0	2	2	4
9	**M21SLO301**	Organic Farming	OE	4	0	0	4	2
10	**M21SL0302**	Skill Enhancement Course	HC	2	0	0	2	2
	Total Credits			**22**	**0**	**6**	**28**	**30**
FOURTH SEMESTER			**HC/ SC/ OE**	**L**	**T**	**P**	**Credits**	**Hours/ Week**
1	**M21SO0401**	Major Project	HC	0	0	10	10	10
2	**M21SOON01**	Swayam course-1	-	-	-	-	2	-
3	**M21SOON02**	Swayam course-2	-	-	-	-	2	-
	Total Credits					**10**	**14**	**10**

Note: Open elective offered by Department of Biotechnology, Organic Farming shall be opted by other schools. MSc Microbial Technology shall have to opt open elective courses offered by other schools.

Semester-wise Summary of Credit Distribution

Semesters	L	T	P	No. of Credits
First Sem	**20**	**0**	**6**	**26**

Second Sem	**18**	**0**	**6**	**22**
Third Sem	**22**	**0**	**6**	**28**
Fourth Sem	**0**	**0**	**10**	**14**
Total Credits	**06**	**0**	**28**	**90**

FIRST SEMESTER

Course code	**Microbiological Methods**	**Course type**	**L**	**T**	**P**	**C**	**CH**

M21SO0101		**HC**	**4**	**0**	**0**	**4**	**4**

1 Prerequisites/Pre reading for the course:

Students should have basic knowledge of culturing of various microorganisms.

Course Objectives:

1. Enable students to understand the basic biomolecules and their role in life.
2. Acquire the knowledge of basic and biological functions of immune system.
3. Enhance the analytical skills related to microbiology.
4. To equip students with methodologies to detect and identify the microbes.

Course Outcomes:

By the end of the course the student will be able to:

1. Characterize the basis and importance's of biochemical reactions involved in cells.
2. Apply the basic knowledge and importance's of immune system in organisms.
3. Apply and analyze the techniques to characterize and identify of microbes.
4. Employ the methodologies to culture and analyses the various microbes.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PS O3
M21SO0101	CO1	3	3	2	3			2	1		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	3
	CO3	3	2	2	2			2			3	3	2	3
	CO4	3	3	2	3	2	2	2	1		3	3	2	3

Course Content:

Unit-I Basic concepts of Chemistry and Biochemistry **13 h**

Chemical formulas and the mole concept. Avogadro's constant. Chemical reaction and equations. Mass relationship in reactions & calculations, Titrations and indicators. Scope and importance of biochemistry, Structure of water, Acid base concept and buffers, pH, Hydrogen bonding, Hydrophobic, Electrostatic and Vander Waals forces. Classification, structure and function of carbohydrates, proteins and lipids. Structure and function of amino acids and vitamins.

Unit-II Microbial life process **13 h**

Bacterial growth and fungal growth- mechanism of reproductions, Measurement of microbial growth, Growth curve and factors influencing the microbial growth. Growth stoichiometry; Kinetics of microbial growth and product formation in batch, Fed batch and continuous cultures. Industrially important microbes and strain improvement.

Unit-III Microscopy and microbiological staining 13 h

Light microscopy- Simple microscope, Compound microscope (Bright field, Dark field, Phase contrast, Fluorescence and confocal). Electron Microscopy- Principles, construction and mode of operation of Scanning, transmission electron microscope, AFM and STEM, limitations and preparation of specimens. Types of stains and principles of staining in microbiology, wet mounting and hanging drop method.

Unit-IV Culture methods and Aseptic Techniques 13 h

Microbiological media-types, cultivation of aerobic and anaerobic bacteria, pure cultures and cultural characteristics. Serial dilution, Pure cultures and isolation techniques, Maintenance and preservation of pure cultures. Principles and methods of Sterilization-Physical and Chemical Sterilization.

Reference

1. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, 6th edition, Mc Graw Hill Higher education (2005).
2. General Microbiology; RY Ingraham, JL Wheels, M.L. Painter, 5th Edition, Thess Macmillan Press Ltd. (2003).
3. Brock Biology of Microorganism; M.T, Martinko, J.M. Parker, Prentice-Hall (2006).
4. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill (2004).
5. Bergey's Manual of Systematic Bacteriology, Breed and Buchanan, 2nd Edition, (Volumes 1-6) (2001 – 2003).
6. General Microbiology; R. Y. Stanier, E. A. Adelberg, J. L. Ingraham, 4th edition, Mac Millan Press, London (2000).
7. Microbiology An introduction; Tortora Funke case (2001).

Course code	Molecular Microbial Genetics	Course type	L	T	P	C	CH
M21SO0102		HC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students to know basics and importance of DNA and RNA.

Course Objectives:

1. Understand the basics of genetic material and hereditary.

2. Study the mechanism of transcription and translation of genetic information.
3. Understand the mechanism of recombinant and genetic transfer in bacteria
4. Discuss the genome structure and functions bacteriophages and eukaryotic microorganisms.

Course Outcome:

By the end of the course the student will be able to:

1. Outline the genetic inheritance in prokaryotic and eukaryotic microorganisms.
2. Explore the mechanism of transcription and translation in microorganisms.
3. Acquire the knowledge of genetic transfer mechanisms in microorganisms.
4. Exploit the knowledge of microbial genetics in allied research.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO3
M21SO0102	CO1	3	3	3	3			1	1	1	3	3	3	3
	CO2	3	3	3	2		1	1		1	3	3	2	2
	CO3	3	3	2	2			1		1	3	3	2	2
	CO4	3	3	2	2		2	2	1	1	3	3	2	2

Course Content:

Unit-I Molecular Basis and life process **13 h**

Nucleic acids as hereditary material and concept of central dogma. Structure and functions of DNA and RNA, Forms of DNA and Types of RNA- rRNA, tRNA and mRNA. RNA Biology- iRNA & miRNA. DNA replication and DNA polymerases of *E. coli* and eukaryotes. Models and enzymes in DNA replication in prokaryotes and eukaryotes. Cell cycle and regulation of DNA replications, molecular mechanism of mutation and DNA repair.

Unit-II Gene Expression and regulation **13 h**

Transcription, RNA polymerases, Types of promoters, Reverse transcriptase and RNA replicase, Genetic code and Translation in prokaryotic and eukaryotic microbes. Post-transcriptional modification, maturation and splicing of RNA transcripts and catalytic RNA. Post-translational modification and protein targeting. Gene regulation at transcriptional & translational level, operon-positive, negative regulation and attenuation (Lac & Trp operon).

Unit-III Gene transfer methods in microorganisms **13 h**

Methods of gene transfer in bacteria-Conjugation-Discovery, nature of donor strains and compatibility, interrupted mating and temporal mapping and molecular pathway of recombination. Transformation-natural transformation systems, Biology of transformation,

transformation and gene mapping, Transduction-discovery, generalized and specialized or restricted transduction.

Unit-IV Genetics of phage and fungi **13 h**

T4 virulent phage-structure, life cycle, genetic map and DNA replication. Lambda phage: Structure, genetic map, lytic and lysogenic cycle. Applications of phages in microbial genetics. Transposons-Insertion sequences and composite transposons, phages as transposons, replicative, non-replicative and conservative transposition. Aspects of fungal Genetics: Meiotic and mitotic mapping, gene conversion, mitotic segregation and recombination, heterothallism and mating type switches.

References

1. Gene IX; Benjamin Lewin Oxford University Press, New York (2005).
2. Principles of Genetics; Snustad and Simmons, 4th Edition, John Wiley and Sons, Inc (2006).
3. Molecular Cell Biology; Lodish et.al., W. H. Freeman and Company (2006).
4. Genomes; T.A. Brown, John Wiley and sons (Asia) PTE LTD, New York (2001).
5. Principles of Gene Manipulation and Genomics; S.B. Primrose and R. M. Twyman, 7th Edition, Blackwell Publishing, U.K (2002).
6. Modern Microbial Genetics; Streips and Yasbin, 2nd Edition Wiley Ltd (2002).
7. Molecular Biology of the Gene; J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine, R. Losick, 7th Edition, Pearson (2014).

Course code	Bioanalytical techniques	Course type	L	T	P	C	CH
M21SO0103		**HC**	**4**	**0**	**0**	**4**	**4**

Prerequisites/Pre reading for the course:

Student should have a knowledge of biomolecules and separation techniques.

Course Objectives:

1. To develop the skills and competency in biochemical techniques
2. To equip with separation of biomolecules through various chromatographic techniques
3. To provide new skills for the separation and characterisation of biomolecules
4. Empower the knowledge of physico-chemistry to analyse the biomolecules

Course Outcome:

By the end of the course the student will be able to:

1. Acquire the basic skill of separation of macro- and micromolecules from biological sources.
2. Develop the biochemical techniques to analyses and quantify the biomolecules.
3. Upgrade the knowledge of biochemical techniques to characterize the biomolecules.
4. Quantitative analysis of biomolecules by various physicochemical methods.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SO0103	CO1	3	3	3	3			1	1		3	3	3	3
	CO2	3	3	2	2	1	1	1			3	3	2	2
	CO3	3	3	2	2	1		1	2	2	3	3	2	2
	CO4	3	3	2	2	1	1	2	1	3	3	3	2	2

Course Content:

Unit -1 Centrifugation **13 h**

Principles of separation techniques, Centrifugation-classification, types and applications, High speed and Ultracentrifugation, Differential and Density-gradient centrifugation, Analytical centrifugation and applications, Factors affecting Sedimentation, Preparative and analytical centrifugation, Safety measures of centrifugation.

Unit -II Chromatography **13 h**

Chromatography techniques classification, factors affecting the separation, Thin layer chromatography, Column chromatography, gel permeation chromatography, ion exchange chromatography, Affinity chromatography, HPLC, GC, applications

Unit -III Electrophoresis **13 h**

Agarose gel electrophoresis, factors affecting separation, troubleshooting, Poly Acrylamide gel electrophoresis, SDS-PAGE, 2D-PAGE; capillary electrophoresis; Isoelectric focusing and isotachophoresis, Hybridization and blotting techniques.

Unit -IV Spectroscopy and Radioactivity **13 h**

Electromagnetic spectrum and interaction of radiation with matter, UV and Visible spectroscopy; Beer-Lambert's law and its limitation; IR spectroscopy- Principles, NMR and ESR, CD/ORD, X-ray crystallography.Mass spectrometry- MALDITOF, TANDEM Mass spectrometry, GC-MS and LC- MS. Radioactivity - Introduction to Isotopes, detection and measurement of radioactivity, Autoradiography, Radio-labeling Techniques and applications.

References

1. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill (2004).
2. Biochemical techniques; Manikam and Sadasivam, New Age International, (2008).

Course code	Research Methodology	Course type	L	T	P	C	CH
M21SOS111		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should be knowing about the research ideas and recent ongoing research works.

Course Objectives:

1. Acquire basic knowledge on qualitative and quantitative methods.
2. Identify and formulate the research problems and design the research.
3. Familiarize the student in using statistical tools in research methods.
4. Student will acquire the knowledge biological information and relevant ethical concerns.

Course Outcome:

By the end of the course the student will be able to:

1. Understand the fundamentals of research and research writings
2. Identify the statement of problem, research gaps and study design in the research
3. Analyze the parametric and non-parametric research data types, sampling methods and use of statistical tools in study design.
4. Apply the data collections, databases and regulations in conducting research.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SO0111	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2

Course Content:

Unit I Fundamental concepts in Research **13 h**

Concept of theory, empiricism, deductive and inductive theory, types of research-qualitative and quantitive research. Utility for research, characteristics of scientific methods-understanding the language of research and language in scientific research.

Unit II Research Problem and Research design **13 h**

Scientific Research-problem, definition, objectives, types, purposes and components of research problem. concept and importance in research-features of a good research design, exploratory research design and descriptive research designs.

Unit III Sampling, data analysis and reporting in research **13 h**

Sampling methods and sampling errors, determining size of the sample. Experimental design-concept of independent & dependent variables. Fundamentals of statistical analysis, correlation and regression. Research reports-structure, components, types and layout of research report and articles, writing and interpreting research results, figures and graphs.

Unit IV Tools in research and Regulatory considerations **13 h**

Research Guides, Handbook, Academic Databases for Biological Science Discipline. Methods to search required information effectively. Data mining tools, searching and bioinformatics databases. Guidelines-animal ethical committee, animal models, various routes of drug administrations, LD50, ED50 and EPA for environment.

References

1. Introduction to research methods: a practical guide for anyone undertaking a research project; C. Dawson, 4th Revised Edition, Oxford: How To Books (2010).
2. Random Data: Analysis and Measurement Procedures; J.S. Bendat, A.G. Piersol, 4th Edition, Wiley (2011)
3. Research in Medical and Biological Sciences: From Planning and Preparation to Grant Application and Publication; P. Laake, H. Benestad, B. Olsen, 1st Edition, Elsevier (2015).
4. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches; J. Creswell, 4th Edition, SAGE Publications (2013).

Course code	Entrepreneurship in Life Sciences	Course type	L	T	P	C	CH
M21SOS112		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should be knowing about business in life sciences and important facts.

Course Objectives:

1. Acquire the knowledge of entrepreneur skills related to life science.
2. Opportunities of business opportunities in various fields of life science.
3. Inculcate the ideas of business development and commercialisation of products/services.
4. Familiarise about the regulations and protection of intellectual property right related to business.

Course Outcome:

By the end of the course the student will be able to:

1. Differentiate the various entrepreneurial skills related to life science.
2. Classify the parameter to access opportunities and constrains, ideas in startups.
3. Explore the systematic process of select and screen of novel business ideas
4. Understand the regulatory bodies in protecting the business.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
M21SOS112	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2

Course Content:

Unit I Fundamentals of Bio-business **13 h**

Concept of Bio-business, contemporary vs antique, bio-business, wealth creation in bio-business, healthcare, biomedical sciences, industrial life sciences and biotechnology, quick survey of regional and global strengths and capabilities, Startups related opportunities, company registration and funding opportunities.

Unit II Life Science based bio-business **13 h**

Agriculture based business, food industry, business related to environment management, bioremediation, bioleaching and waste management. Case studies of business failure and success stories, biotech clusters, process of business commencement, ethics in business, reason for business failures, causes and preventive measures.

Unit III Entrepreneurship development **13 h**

Myths of Entrepreneurship, factors affecting entrepreneurship growth, future of entrepreneurship, entrepreneurship development programs (EDP) technology business incubator, open discussion recent updates, group project presentation: case studies of different industries and their strategic planning.

Unit IV Protection of IP in bio-business **13 h**

Opportunities for business, Policy and Regulatory Concerns, Human Resource, Financing incentives and subsidies & bounties for business units by government and NGOs. Intellectual Property, Technology Licensing and Branding, Patenting-country of origin and international origin, Copyright, Geographical Indicator, Trade Secret and case studies.

Reference

1. 101 Real Life Business Lessons for Emerging Entrepreneurs Hardcover; B. Green, Koehler Books (2017).
2. Tools of Titans: The Tactics, Routines, and Habits of Billionaires, Icons, and World-Class Performers; T. Ferriss, Random Houses (2016).
3. My Misadventure in the Start-Up Bubble; D. Lyons, Hachette Books (2016).
4. An Entrepreneur's Vision of the Future; S. Case, Simon & Schuster (2016).
5. Pivot: The Only Move That Matters Is Your Next One; Jenny Blake, Portfolio (2016).

Course code	Cell Culture Technology	Course type	L	T	P	C	CH
M21SOS121		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should be knowing about the culturing of cells and its importance in research.

Course Objectives:

1. Explain the different types of cell lines in animal cell culture techniques
2. Deep understanding of the composition and preparation methodology of the different types of cell culture media.
3. Illustrate the importance and methodology for transferring genes into the different types of animal and plant cells.
4. Apply the knowledge for a better understanding of the different explant-based plant tissue culture callus formation and as suspension culture methods.

Course Outcome:

By the end of the course the student will be able to:

1. Elaborate the fundamentals of animal cell culture and types of media used in animal cell culture.
2. Classify the different types of stem cells as well as compare and contrast the various types of stem cells and outline the different cord blood-based stem cell techniques.
3. Extend and apply the fundamental knowledge for the production of animal and plant tissue culture- based products.
4. Outline the methods involved in gene transfer techniques in animal and plant cells.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO 3
M21SOS121	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2

Course Content:

Unit I Cell culture techniques **13 h**

Essentials of animal cell culture-Animal cell culture, primary cells, cells lines. Adherent and non-adherent cells. Resources of cell lines and viability testing. Media and methods to culture animal cells. Subculturing and maintenance of animal cells. Medium preparation and methods to avoid contamination. Continuous and batch mode of large-scale cell culture. 2D and 3D culture methods. Methods for encapsulation of animal cells and its advantages. Methods for Immortalization of primary cells and industrial applications of cell culture.

Unit II Stem cell technology **13 h**

Embryonic stem cells, cord blood stem cells, Induced pluripotent stem cells. Difference between Totipotent, Multipotent and pluripotent stem cells. Methods for obtaining the stem cells and their advantages with drawbacks. Methods for tissue development using in vitro cultured cells.

Unit III Plant tissue and cell culture **13 h**

Different explants used for plant tissue culture with advantages and disadvantages. Callus and suspension culture. Methods to induce callus from explants, somatic embryos. MS medium, shoot medium and root medium. Methods in plant cell culture for crop improvement. Production of metabolites using plant cell suspension culture, Bioelicitation studies, Industrial application of Plant cell culture.

Unit IV Gene transfer techniques in to host cells **13 h**

In Animal cells- Transfection, Transduction, electroporation. Transient and stable expression of transgene in animal cells and Plant Cells- Protoplast fusion technique and its advantages. Methods for gene transfer in plant cells and generation of transgenic plants. Selection and identification techniques of transformants in plants and animal cells.

References

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; R.I. Freshney, 6th Edition, Elsevier, (2011).
2. Plant Cell Culture: Essential Methods; M.R. Davey, P. Anthony, Springer (2010).
3. Plant Cell Culture Protocols; L. Vargas, M. Víctor, Ochoa-Alejo, Springer (2012).
4. Embryonic Stem Cells; J.R Masters, B.O. Palsson, J.A. Thomson, 6th Volume, Springer (2010).

Course code	Microbial Metabolites	Course type	L	T	P	C	CH
M21SOS122		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have basic knowledge of commercial products from microbes.

Course Objective:

1. Acquire the knowledge of various metabolites from microbes and their applications
2. Describe and design a microbial production of primary metabolites from microbes.
3. Inculcate the various microbial metabolites and their importance
4. Familiarise about the value-added products from the microbes.

Course Outcome:

By the end of the course the student will be able to:

1. Productively translate both basic and frontiers research concepts relating to metabolite production and purification into a modern industrial bioprocess perspective.
2. Describe and analyse the control of in vitro cellular growth processes within the industrial scale bioreactor environment,
3. Demonstrate a technical lexicon that will allow productive interface with complementary disciplines.
4. Discuss and evaluate the operational considerations and downstream processing of biotechnology products.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOS122	CO1	3	3	3	3			2	2		3	3	3	3
	CO2	3	2	2	2			2			3	3	2	2
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	2	3	1	1	2	2	2	3	3	2	2

Course Content:

Unit I Microbial products as primary and secondary metabolites 13 h

Metabolites- trophophase- Ideophase relationships in production of secondary metabolite; Role of secondary metabolites in physiology of organisms producing them; Pathways for the synthesis of primary and secondary metabolites of commercial importance; Metabolic control mechanisms: substrate induction; catabolic regulation; feedback regulation; amino acid regulation of RNA synthesis; Energy charge regulation and permeability control; Bypassing/ disorganization of regulatory mechanisms for overproduction of primary and secondary metabolites

Unit II Microbial Primary metabolites production 13 h

Fermentation process and phases of metabolite production, metabolic pathways and their fermentation products. Organic feedstock: ethanol; Acetone; Ethanol Organic acids: Production of Citric acid; Acetic acid; Lactic acid; Gluconic acid; Kojic acid; itaconic acid; Amino acids: Use of amino acids in industry; methods of production; Production of individual aminoacids (L-Glutamic acid; L Lysin; L-Tryptophan).

Unit III Microbial enzymes 13 h

Enzymes-classification, nomenclature and commercial applications of enzymes in various fields, production of Amylases; Glucose Isomerase; L Asparaginase Proteases Renin; Penicillin acylases; Lactases; Pectinases; Lipases; Structure and biosynthesis Nucleosides Nucleotides and related compounds.

Unit IV Microbial Vitamins and value-added products 13 h

Vitamins-Vitamin B12; Riboflavin; B carotene; Antibiotics: beta-Lactam antibiotics; amino acid and peptide antibiotics; Carbohydrate antibiotics; Tetracycline and antracyclines; Nucleoside antibiotics; Aromatic antibiotics; bioplastics (PHB; PHA); biotransformation of steroids.

References

1. A Textbook of Industrial Microbiology; W. Crueger and A. Crueger, Sinauer Associates (2010).
2. Industrial microbiology; G. Reed, CBS (2010).
3. Biology of Industrial microorgnaisms; A.L. Demain (2012).
4. Principles of fermentation technology; P. Stanbury, A. Whitaker and S.J. Hall, 3rd Edition (2016).
5. Fermentation and Biochemical Engineering Handbook: Principles, Process Design, and Equipment; H.C. Vogel, C.L. Todaro, C.C. Todaro, Noyes Data Corporation/ Noyes Publications (2015).
6. New Products and New Areas of Bioprocess Engineering (Advances in Biochemical Engineering/Biotechnology, 68); T. Scheper. Springer Verlag (2012).

Course code	Microbiological methods LAB	Course type	L	T	P	C	CH
M21SO0104		HC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should be aware of various culture media and culturing aspects of microorganisms.

Course Objectives:

1. Practical exposure in isolation of microorganisms from different samples
2. Analyse various staining and quantification procedures used in microbiology
3. Determine the biochemical analysis of carbohydrates, proteins and fats
4. Estimation and preparations of the reagents and solutions for biochemical assay

Course Outcomes:

By the end of the course the student will be able to:

1. Hands on exposures to isolate and quantify the microorganisms
2. Exploit the staining protocols used in the microbiology
3. Quantify the carbohydrates and protein in the various samples
4. Exploit the preparation and analysis of reagents and buffers for biochemical analysis.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0104	CO1	3	3	3	3	2		2		2	3	3	3	3
	CO2	3	3	3	2	2		2		2	3	3	3	3
	CO3	3	2	2	2	2		2		2	3	3	2	2

	CO4	3	3	3	3	2		2		2	3	3	2	2

Course Content:

1. Isolation of microflora from air, soil and water.
2. Simple staining techniques in microbiology.
3. Differential staining techniques in microbiology.
4. Sugar fermentation tests, urease test, triple sugar iron test, oxidase, lipid, DNAse, catalase and casein hydrolysis test.
5. Enumerating the yeast cells by the hemocytometer
6. Preparation of standard and buffer solutions.
7. Estimation of microbial total sugars by anthrone method.
8. Estimation of microbial reducing sugars by DNS method.
9. Estimation of Microbial proteins by Lowrys' method
10. Estimation of saponification and iodine value of oils and fats from microbes

Reference

1. Analytical techniques in Biochemistry and molecular Biology; R. Katoch, Springer (2011)
2. Basic Methods for the Biochemical Lab; M. Holtzhaue, Springer (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology; K. Wilson and J. Walker, 7th Edition, Cambridge University Press (2010).
4. Experiments in Applied Microbiology; S. Singer Academic Press (2001).
5. Microbiological methods; C.H. Collins, M.L. Tatrica and J.M. Grange, 8th Edition, Hodder Arnold publishers (2004).

Course code	Molecular Microbial Genetics LAB	Course type	L	T	P	C	CH
M21SO0105		HC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have basic knowledge of isolation of DNA from cells.

Course Objectives:

1. Practical knowledge on the DNA and RNA analysis
2. Determine the DNA and RNA in the various samples
3. Understand the bacterial genetic process occurring in nature
4. Inculcate the molecular mechanism for the research uses.

Course Outcomes:

By the end of the course the student will be able to:

1. Practical approaches in the DNA and RNA analysis
2. Estimate the DNA and RNA in the various samples
3. Demonstrate the bacterial process happening in nature
4. Experiment the molecular analysis of research purpose

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0105	CO1	3	3	3	3			2			3	3	3	3
	CO2	3	3	3	2			2			3	3	3	3
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	3	3			2			3	3	2	2

Course Contents:

1. Isolation of bacterial genomic DNA and analysis by AGE
2. Isolation of plasmid DNA and analysis by AGE
3. Estimation of DNA by DPA method.
4. Estimation of RNA by orcinol method.
5. Bacterial transformation by α-complementation.
6. Demonstration of Bacterial conjugation
7. Demonstration of Bacterial transduction
8. Isolation of streptomycin resistant strain of *E. coli* by gradient plate method
9. Replica plating technique for transfer of bacterial colonies.
10. Induction of mutation in the *E coli* by EMS

Reference

1. Molecular Biology of the Cell; B. Alberts, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts, P. Walter, 6th Edition, Garland Science publisher (2014).
2. Molecular Cell Biology; H. Lodish, A. Berk, C.A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, A. Amon, M.P. Scott, 7th Edition, Macmillan Publishers (2012).
3. The Cell: A molecular approach; G.M. Cooper and R.E. Hausman, 7th Edition, Sinauer Associates, USA (2016).

Course code	Bioanalytical techniques LAB	Course type	L	T	P	C	CH
M21SO0106		HC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of separation and analysis of biomolecules.

Course Objectives:

1. Hands on experience in the preparation of reagents and buffers
2. Acquire analytical skills in determination of molecular weight of microbial proteins
3. Exploit the various advanced skills for separation and characterisation of biomolecules.
4. Optimization of protein purification through various methods.

Course Outcomes:

By the end of the course the student will be able to:

1. Equipped with biochemical techniques for handling the biomolecules.
2. Apply the knowledge of practical skills in separation of biomolecules
3. Explore various methods to characterize the biomolecules.
4. Quantify the biomolecules with optimized methods.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SO0106	CO1	3	3	3	3			2			3	3	3	3
	CO2	3	3	3	2			2			3	3	3	3
	CO3	3	2	2	2			2			3	3	2	2
	CO4	3	3	3	3			2			3	3	2	2

Course Contents:

1. pH metric titrations for determining p Ka of a weak acid for optimizing buffer capacity
2. Separation of bacterial proteins by paper chromatography
3. Separation of bacterial proteins by TLC
4. Separation of extracts by Silica gel column chromatography.
5. Separation of proteins by sepharose column chromatography.
6. Separation of Immunoglobulin by affinity chromatography.
7. Molecular weight detection of separated proteins by silver staining of SDS PAGE
8. Molecular weight detection of separated proteins CBB staining by SDS PAGE.
9. Demonstration of separation of metabolites by HPLC

10. Demonstration of analysis of GC-MS.

References

1. Principles of Biochemistry; Lehninger and D.L. Nelson, 6th Edition, Macmillan Publications (2012)
2. Genes XI, L. Benjamin, J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick, Jones and Bartlett Learning (2014).
3. Biochemistry; J.M. Berg, J.L. Toymoczko and LubertStrye, 8th Edition, Macmillan Publications (2015).

SECOND SEMESTER

Course code	Microbial Metabolism and Physiology	Course type	L	T	P	C	CH
M21SO0201		HC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should be aware of basic concepts of microbial process in the nature.

Course Objectives:

1. Gain the knowledge of microbial photosynthesis and their extreme adaptations.
2. Understand the microbial metabolic pathway occurring in the nature.
3. Explore the better understanding of lipid and nucleic acid metabolism.
4. Exploit the biological nitrogen fixation for other applications.

Course Outcomes:

By the end of the course the student will be able to:

1. Explain the various pathways involved in microbial photosynthesis
2. Utilize the microbial metabolic pathways for commercial uses
3. Exploit the various metabolic process in degradation of lipids and nucleic acids
4. Explore various nitrogen fixation mechanism for commercial uses

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0201	CO1	3	3	3	3		3	3			3	3	2	2
	CO2	3	3	2	2		2	2			3	3	2	2

	CO3	3	3	2	2		2	2			3	3	2	2
	CO4	3	3	2	2		2	2			3	3	2	2

Course Contents:

Unit-I Microbial photosynthesis **13 h**

Brief account of microbial photosynthesis – oxygenic and anoxygenic photosynthesis; fixation of CO_2-Calvin cycle-C3-C4 pathway. Chemolithotrophy – sulphur, iron, hydrogen, nitrogen oxidations, methanogenesis and luminescence.

Unit-II Microbial metabolism of carbohydrates **13 h**

Respiratory metabolism-glycolysis, Entner Doudroff pathway, glyoxalate pathway, Krebs cycle-oxidative and substrate level phosphorylation-reverse TCA cycle. Fermentation-homo and heterolactic fermentation. Enzymes-classification, mechanism of action; Factors affecting enzyme action and Immobilized enzymes.

Unit-III Metabolism of lipids and nucleic acids **13 h**

Lipid metabolism: β-oxidation, Biosynthesis of fatty acids, degradation of fatty acids. Synthesis of purines and pyrimidines-de novo and salvage pathways. Biosynthesis of glycoproteins and peptidoglycan.

Unit-IV Nitrogen Metabolism **13 h**

Nitrogen metabolism, Biological nitrogen fixation process by symbiotic bacteria and by free living bacteria and cyanobacteria, symbiotic and non-symbiotic nitrogen fixation. urea cycle, degradation and biosynthesis of essential and non-essential amino acids.

Reference

1. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill (2004).
2. Principles of Biochemistry; Nelson and Cox, 5th Edition, W.H. Freeman & Co., New York, (2010).
3. Biochemistry; D. Voet and J.G. Voet, John Wiley and Sons, Inc (2000).
4. Microbial Physiology; A.G. Moat, 4th Edition, Wiley (2000).

Course code		**Course**	**L**	**T**	**P**	**C**	**CH**

	Microbial diversity (HC)	type					
M21SO0202		**HC**	**4**	**0**	**0**	**4**	**4**

Prerequisites/Pre reading for the course:

Students should have basics of different classes of microorganisms and their importance.

Course Objectives:

1. Acquire knowledge and explore the diverse form microorganisms.
2. Illustrate the various importance's and applications of microorganism.
3. Explore the eukaryotic microorganisms and their applications in various field.
4. Explore the microbial ecology and its importance in environmental sustainability.

Course Outcomes:

By the end of the course the student will be able to:

1. Acquire the basic knowledge of diverse microbial life and their classifications.
2. Explore the recent methodologies in field of microbiology.
3. Exploit the biology and significance of bacteria and viruses in other areas.
4. Utilize the biological and significance of eukaryotic microbes for commercial purpose.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SO0202	**CO1**	3	3	2	3	2		2		1	3	3	3	2
	CO2	3	3	2	2	3		2		1	3	3	3	2
	CO3	3	3	2	2	3		2		1	3	3	3	2
	CO4	3	3	2	2	3		2		1	3	3	2	2

Course Content:

Unit-I Microbial World and Microbial Taxonomy 13 h

Origin and historical development of Microbiology, contribution of microbiologist, biogenesis & abiogenesis theory. Microbiology as interdisciplinary science, importance and scope. Five kingdom and domain classification, classification criteria in microbiology, Bergeys' classification, binomial nomenclature and classification systems in different microbial classes. Molecular tools of 16 S rRNA and 18S rRNA sequencing and phylogenetic analyses.

Unit-II Importance and Conservation of Microbial Diversity 13 h

Importance of microbial diversity in agriculture, forestry, environment, industrial & food biotechnology, animal & human health. Metagenomics approaches in the microbial community's determination. Importance of conservation. In situ conservation and Ex situ conservation. Role of culture collection centers in conservation.

Unit-III Bacterial and Viral Diversity **13 h**

Brief history of bacteriology, general characteristics of bacterium, classification of bacteria based on the morphology, flagella and nutritional aspects, ultrastructure of bacterial cells and functions of bacterial structure.

Brief history of virology, general characteristics, classification of viruses, life cycle of bacteriophage (lambda, T4, M13), human virus (polio, hepatitis) and plant virus (TMV, CaMV) importance.

Unit-IV Fungal and Algal Diversity **13 h**

Fungal characteristics, growth, reproduction, life cycle, classification & importance. Study of thallus structure, reproduction and life cycle of *Pythium, Rhizopus, Saccharomyces, Aspergillus, Penicillium, Fusarium and Agaricus*. Major applications of fungi in various fields.

Algae characteristics, structures, growth, reproduction, life cycle, classification & importance. Study of thallus structure, reproduction and life cycle of Cyanobacteria, Chlorella, Scenedesmus, Spirogyra, Diatoms and Gracilaria. Various applications of algae.

Reference

1. Introductory Mycology; C.J. Alexopoulos and C.W. Mims, 3rd Edition, Wiley Eastern, New Delhi (2007).
2. Introduction to Modern Virology; N.J. Dimmock, A.J. Easton and K.N. Leppard, 5th Edition, Blackwell publishing, USA (2001).
3. Natural Resource Conservation and Environment Management; A. Ghosh, Aph Publishing Corp. Calcutta (2008).
4. Brock Biology of microorganisms; M.T. Madigan, M.J. Martinko and J. Parker, Pearson Education (2003)
5. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill (2004).
6. Microbial Diversity–Current Perspectives and Potential Applications; T. Satyanarayana and B.N. Johri, I K Int. Pvt. Ltd. New Delhi (2005).

Course code	Bioinformatics and Biostatistics	Course type	L	T	P	C	CH
M21SO0203		HC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have basics of computers and mathematical calculations**.**

Course Objectives:

1. To introduce the basic knowledge of bioinformatics
2. To emphasis the applications of bioinformatics in biological research
3. To develop knowledge on various kinds of research design
4. To acquire basic knowledge on quantitative and qualitative analysis.

Course Outcome:

By the end of the course the student will be able to:

1. Apply the knowledge of computational biology in database analysis
2. Inculcate the fundamentals of binary genomic data analysis
3. Develop the new algorithms, methods and computational modeling in drug discovery
4. Inculcating application knowledge of biostatistical methods to evaluate biological data

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO3
M21SO0203	CO1	3	3	2	3	2		2		1	3	3	3	2
	CO2	3	3	2	2	3		2		1	3	3	3	2
	CO3	3	3	2	2	3		2		1	3	3	3	2
	CO4	3	3	2	2	3		2		1	3	3	2	2

Course Content:

Unit-I Biological databases and analysis **13 h**

Introduction to NCBI, NCBI, EMBL and other genomic data bases, Searching PubMed, BLAST, BLASTn, BLASTp, PSI-BLAST, searching sequence databases for sequence similarity; Multiple sequence alignment, Phylogenetic Analysis; Primer designing. Genome sequencing, sequencing platforms, sequence file types, data structures. Classification of microbes using genome sequencing. Differential gene expression prediction, functional annotation, functional enrichment analysis.

Unit-II Biological Data Retrieval and Analysis **13 h**

Introduction and scope of bioinformatics, biological information resources, genome sequence acquisition and analysis, data acquisition, biological databases, structure and annotation, data mining and data characteristics, scoring matrix, sequence alignment and database searches, pair wise and multiple sequence alignment.

Unit-III Bioinformatics in Drug discovery **13 h**

Conceptual model of protein structure, Structural types and conceptual models, Globular proteins, secondary structure, tertiary structure, integral membrane proteins and domains. Protein structure analysis, Molecular docking. Bioinformatics in the Pharmaceutical Industry-QSAR method; ADMET Predictions.

Unit-IV Data processing and Statistical analysis **13 h**

Processing and Analysis of Data; processing operations, problems in processing, Types of analysis, statistics in research, importance of statistical analysis. Measure of relationship-simple regression, multiple correlation and regression analysis, Analysis of variation (ANOVA) and co-variation, Meta-analysis, networking and Dataperl.

Reference

1. Introduction to Bioinformatics; T. Attwood and P.S. David, Pearson Education Ltd., New York (2006)
2. Bioinformatics A Practical Guide to Analysis of Genes and Proteins; A.D. Baxevanis and B.F.F. Ouellette, 3rd Edition. John Wiley and Sons, New York (2006).
3. Bioinformatics and molecular evolution; T.K. Attwood and P.G. Higgs, Blackwell Publishers, London (2005).
4. Introduction to Bioinformatics; A.M. Lesk, Oxford University Press, (2002).

Course code	Microbiology for Sustainable Environment	Course type	L	T	P	C	CH
M21SOS211		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should know about the role of microbes in environment and their importance.

Course Objective:

1. Facilitate the students to understand role of microbes in environment suitability.
2. Impart the knowledge of pollution control and waste management in society.
3. Utilization of beneficial microbes for sustainable agriculture.
4. Inculcate the knowledge to produce bioenergy from using waste.

Course Outcome:

By the end of the course the student will be able to:

1. Acquire the knowledge of role of various microorganisms in life cycle of organisms.
2. Identify the different types of pollution and their management strategies.
3. Increase the plant productivity using the ecofriendly microbial management in soil.
4. Impart the knowledge of energy production from microorganisms using organic waste.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SOS211	CO1	3	3	3	3		2	3		1	3	3	2	2
	CO2	3	2	2	2		2	3		1	3	3	2	2
	CO3	3	2	2	2			3		1	3	3	2	2
	CO4	3	3	2	2		2	2		1	3	3	2	2

Course Contents:

Unit-I Microbes in environment **13 h**

Role and diversity of microbes in nature, culture based and non-culture-based technique to study microbes in environment. Biogeochemical cycles-N, C, S and other cycles with the role of microorganisms. Pathogens of animals, humans and plants in nature and saprophytes in environment.

Unit-II Waste management **13 h**

Solid and Liquid waste Treatment of sewage and industrial effluents, Secondary waste treatment – aerobic, anaerobic and Composting, Biofuels – ethanol, methane and biohydrogen. Bioleaching of Metals, Microbes as food, bioplastics from microorganisms, Genetically modified microbes – Application and hazards.

Unit-III Microbes in sustainable agriculture **13 h**

Role of Microbes in Agriculture – bioinoculants-types – bacterial, fungal and algal-nitrogen fixers, mineral solubilizes and other types, biodegradation of xenobiotic compounds-pesticides and petroleum products, techniques of bioremediation using microbes.

Unit-IV Microbes in waste to products **13 h**

Microbial Enhanced Oil Recovery, Bio-ethanol and bio-diesel production, commercial production from lignocellulosic waste, Algal biomass for fuel; Biogas production: Methane and hydrogen production using microbial culture.

References

1. Wood and Cellulosic Chemistry; D.N.S. Hon, S. Nobuo, CRC Press (2000).

2. Renewable Energy; B. Sorensen, Academic Press (2010).
3. Sustainable Bioenergy and Bioproducts; G. Kasthurirangan, J.H. van Leeuwen, C. Robert; Springer (2012).
4. Advances in Clean Energy Technology, A.K. Azad, Elsevier (2020).

Course code	Microbial food processing	Course type	L	T	P	C	CH
M21SOS212		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have knowledge of microorganism in food industries.

Course Objective:

1. To provide the basic knowledge of microbes associated with food.
2. To provide the impact of microbes in food spoilage and preservation.
3. To study the microbial process of beneficial microbes in food industry.
4. To acquire the knowledge of microbial food safety measures.

Course Outcome:

By the end of the course the student will be able to:

1. Better understanding of microbes associate with food.
2. Apply the scientific knowledge of evaluate the food spoilage and preservations.
3. Apply various microbial techniques in developing probiotics
4. Aware of various ethical reasoning in the discipline of food technology.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PS O3
M21SOS212	CO1	3	3	3	3		2	3		1	3	3	2	2
	CO2	3	2	2	2		2	3		1	3	3	2	2
	CO3	3	2	2	2			3		1	3	3	2	2
	CO4	3	3	2	2		2	2		1	3	3	2	2

Course Content:

Unit I Microbial association of the food **13 h**

Structure, properties and metabolic functions of food constituents - composition and nutritive value of common food items - organoleptic properties of food– undesirable constituents in food. Microorganisms associated with food – Harmful and beneficial effects of microbes – Various factors viz. Intrinsic factors, extrinsic factors, Implicit factors, processing factors affecting microbial growth

Unit II Microbial food spoilage and food preservations **13 h**

Microorganisms and food spoilage– Spoilage of fruits, vegetables, fresh and processed meat, poultry and seafood and other miscellaneous foods - Food borne microbes causing health hazards- Food poisoning and intoxication - causes – symptoms – strategies employed for prevention and cure. Physical and chemical methods of preservation biopreservation, Food additives, definition, types and function, processing of selected dairy and poultry products- Methods for maintaining high quality food products

Unit III Probiotics and lactic acid bacteria **13 h**

Types of lactic acid bacteria – homofermentation and heterofermentation – Role of LAB in fermented food products – Genetic transfer systems in lactic acid bacteria -- Uncontrolled and controlled genetic alterations in lactic acid bacteria - Use of genetically modified LAB in food production - antibiotics – Probiotics and its importance.

Unit IV Microbial detection of Food and food laws **13 h**

Conventional methods - Membrane filters- Microscope colony counts - agar syringe methods - surface methods – rapid detection methods - nucleic acid-based methods - biosensors - immunological methods. Inspection – Microbial Indicators of product quality – Indicators of food safety – Microbiological safety of foods - control strategies – Hazard Analysis Critical Point System (HACCP concept)- Microbiological criteria.

Reference

1. Food Microbiology; J.M. Jay, M.J. Loessner, D.A. Modern, 7th Edition, CBS Publishers, New Delhi, India (2011).
2. Food Oxidants and Antioxidants-Chemical, Biological, and Functional Properties; G. Bartosz, 1st Edition, CRC Press, New York, USA (2014).

3. Food Safety Management-A Practical Guide for the Food Industry; Y. Motarjemi, H. Lelieveld, 1st Edition, Academic Press, London, UK (2014).
4. Food Microbiology; Adams, R. Martin, M.O. Moss, 3rd Edition, Royal Society of Chemistry, Washington DC, USA (2017).

Course code	Microbial Metabolism and Physiology (LAB)	Course type	L	T	P	C	CH
M21SO0204		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should know the basics of biochemical testing and culturing of microbes.

Course Objective:

1. Explore the practical aspects of isolation and culturing of microorganisms
2. Exploit the practical knowledge of microbial enumerations.
3. Analytical techniques to evaluate the microorganisms associated with various samples
4. To identify and characterise the microbial products by various metabolic process.

Course Outcome:

By the end of the course the student will be able to:

1. Hands on experience in enumeration of microbes.
2. Development of practical skills in microbial technology.
3. Exploit the knowledge of microbial enzyme for commercial use.
4. Acquire enhanced microbial products to meet the nutritional requirements.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SO0204	CO1	3	3	2	2	2	1	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	1	2	3	2	2

Course Content:

1. Determination of viable and total number of cells.

2. Measurement of cell size, Growth – types of growth (synchronous, diauxic, batch),
3. Study factors affecting growth
4. Sporulation and spore germination in bacteria
5. Induction and repression of enzymes
6. Study of bacterial growth under aerobic, micro, aerophilic and anaerobic conditions
7. Morphological, Physiological and Biochemical tests of selected bacterial cultures.
8. Production of amino acids (Leucine and Glutamic acid) by microorganisms.
9. Production of vitamins (Vitamin-A) by microorganisms.
10. Production of extracellular enzymes-Amylase

Reference

1. Microbiology Applications – (A Laboratory Manual in General Microbiology); H.J. Benson, Wm C Brown Publishers (2010).
2. A Laboratory Manual in Biochemistry; J.G. Cappuccino and N. Sherman, Addison-Wesley (2010).
3. Laboratory Techniques in Biochemistry and Molecular Biology; T.S. Work and R.H.E. Work, Elsevier Science (2010).

Course code	Microbial diversity LAB	Course type	L	T	P	C	CH
M21SO0205		HC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of diverse class of microbes and their culturing aspects**.**

Course Objectives:

1. Enumeration of microflora from food and water samples.
2. Explore beneficial microflora from soil samples.
3. Identify the phytopathogens from soil microflora.
4. Quantitative estimation of microflora in various samples.

Course Outcome:

By the end of the course the student will be able to:

1. Inculcate the knowledge the of analysing the microflora in various samples.
2. Exploit the use of beneficial microflora for commercial purpose.
3. Identification and characterisation of phytopathogens.

4. Quantitative analysis of microflora in different samples

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0205	CO1	3	3	2	2	2	2	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	2	2	3	2	2

Course Content:

1. Isolation and identification of bacteria from food and water.
2. Isolation and identification and study of actinomycetes from soil.
3. Isolation and identification and study of cyanobacteria from soil / paddy field.
4. Isolation and study of bacteriophages from sewage.
5. Preparation of basic solid media agar slants and agar deep tubes for cultivation of fungi.
6. Isolation and identification of fungi from soil/cereals/water by serial dilution technique.
7. Staining of vesicular arbuscular mycorrhizae from soil.
8. Isolation and identification and study of algae from water.
9. Isolation and identification and study of phytopathogens.
10. Measurement of concentration of microorganism by hemocytometer

Reference

1. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, 6th edition, Mc Graw Hill Higher education (2005).
2. Microbial Diversity–Current Perspectives and Potential Applications; T. Satyanarayana and B.N. Johri, I K Int. Pvt. Ltd. New Delhi (2005).
3. Biodiversity of Microbial Life: Foundation of Earth's Biosphere; J.T. Stanley, A.L. Reysenbach, Wiley Publication, New York (2001).

Course code	Bioinformatics and Biostatistics LAB	Course type	L	T	P	C	CH
M21SO0206		SC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical background of computers and software's for statistical studies.

Course Objectives:

1. To acquire fundamental knowledge of bioinformatics techniques.
2. Emphasis on application of bioinformatics in biological databases to resolve research problems.
3. Practical exposure to use wide applications computational biology and apply the same to resolve biological research.
4. To evaluate the biological data using the biostatistics tools.

Course Outcome:

By the end of the course the student will be able to:

1. Inculcate the knowledge of basic principles and concepts of computational biology.
2. Evaluate the basic information of biological database.
3. Conceptualize the molecular modelling of biological data and its applications.
4. Problem solving skills in qualitative and quantities analysis of data

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SO0206	CO1	3	3	2	2	2	1	1	1	1	3	3	2	2
	CO2	3	2	2	2	2	1	1		2	2	3	2	2
	CO3	3	2	2	2	2		1		1	2	3	2	2
	CO4	3	2	2	2	1	1	2	1	1	2	3	2	2

Course Content:

1. BLAST-finding scores, E-values, Sequence alignment.
2. Phylogenetic analysis
3. Gene prediction methods
4. Primer designing
5. Protein structure prediction
6. Protein structure visualization and interpretations.
7. Protein Structure validation, active site predictions and molecular docking.
8. Developing a vector map using a software.
9. Calculation of mean, median and mode
10. Analysis of data for ANNOVA and student t-test using SPSS and GraphPad.

Reference

1. Introduction to Bioinformatics; T. Attwood, P.S. David, Pearson Education Ltd., New York (2006).
2. Bioinformatics A Practical Guide to Analysis of Genes and Proteins; A.D. Baxevanis, B.F.F. Ouellette, 3rd Edition. John Wiley and Sons, New York (2006).
3. Bioinformatics and molecular evolution; T.K. Attwood, P.G. Higgs, Blackwell Publishers, London (2005).
4. Introduction to Bioinformatics; A.M. Lesk, Oxford University Press (2002).

THIRD SEMESTER

Course code	ORGANIC FARMING	Course type	L	T	P	C	CH
M21SLO301		**OE**	**4**	**0**	**0**	**4**	**4**

Prerequisites/Pre reading for the course:

Students should know the organic farming basics and its importance.

Course Objectives:

1. Understand the importance of organic farming in developing a sustainable agriculture system for ensuring adequate food production.
2. Acquire the holistic concept of organic farming as a self-sustainable unit in the ecosystem.
3. Get familiarized with the practices involved in the organic farming system.

Course Outcomes:

By the end of the course the student will be able to

1. Analyse the advantages of organic farming compared to conventional chemical agriculture.
2. Understand the significance of plant nutrient management following organic practices.
3. Apply the knowledge gathered in implementing the practices in organic crop production and plant protection.
4. Explain the basic principles involved in organic farming production, certification and marketing.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SLO301	CO1	2	3		3	2		3				3	3	2

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

Course Content:

Unit I Introduction to Organic Farming 13 h

Organic farming, concept and development of organic farming. Principles of organic farming & need for organic farming, Agencies and institutions related to organic agriculture. Farm components for an organic farm. Benefits of organic farming. Conventional farming v/s organic farming. Scope and present state of organic farming; its relevance to India and global agriculture and future prospects.

Unit II Organic Plant Nutrient Management 13 h

Organic farming systems: Soil tillage, Choice of Varieties, crop rotation, multiple cropping systems, intercropping. Propagation: planting materials and seed treatments. Water management, Organic manures: Green manuring, Composting: Composting methods, Vermicomposting, Organic amendments and sludges, biogas. Bio-fertilizers-: methods of application and advantages.

Unit III Organic Plant Protection 13 h

Plant protection: cultural, mechanical methods. Biological methods: botanical pesticides, biopesticide, biocontrol agents. Weed management. National and international Standards for organic inputs- plant protection; Integrated pest management. Organic crop production methods: arecanut, okra. Live-stock component and management in organic farming.

Unit IV Organic Certification 13 h

Farm economy; Basic concept of economics- Demand, supply, Economic Viability of a farm. Basic production principles, Reducing expenses, ways to increase returns. Cost of production system. Marketing, Imports and exports. Policies and incentives of organic production, Farm inspection and certification: Income generation activities: Apiculture, Mushroom production, Terrace farming.

Reference

1. Organic Farming – Theory and Practice; S.P. Palaniappan, K. Anandurai, Scientific Publishers Journals Dept. (2010).
2. Soil organisms and litter decomposition (in Modern trends in applied terrestrial ecology); G. González, Springer, Boston (2002).
3. Hand Book of Organic Farming, A. Sharma, Agrobios (2002).
4. Soil Microbiology; N.S. Subba Rao, Oxford & IBH (2002).

Course code		Course	L	T	P	C	CH

	Nanobiology and Space Microbiology	type					
M213SOS311		**OE**	**4**	**0**	**0**	**4**	**4**

Prerequisites/Pre reading for the course:

Students should have a knowledge of nanotechnology in life sciences and its importance.

Course Objectives:

1. Better understand of the synthesizes and characterization of nanomaterials
2. Describe various types of nanomaterials and their applications
3. Apply the knowledge to understand the application of nanomaterials in allied sciences
4. Have Insight and deep knowledge of space microbiology and its importance

Course Outcomes:

By the end of the course the student will be able to

1. Describe the basic science behind the properties of materials at the nanometre scale
2. Understand the principles behind advanced experimental and computational techniques for studying nanomaterials.
3. Systematically solve scientific problems related specifically to nanotechnological materials using conventional scientific and mathematical notation.
4. Explain primary aspects of space microbiology that have been studied to date.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M213SOS311	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Contents:

Unit I Concepts, synthesis and characterization of nanomaterials 13 h

Basic and functional principles of nanotechnology, basic biology principles and practice of micro and nanofabrication techniques. Synthesis approaches and methods, characterization of nanomaterials by spectroscopic and microscopic techniques, Biological production of nanoparticles, macro molecular assemblies and its significances.

Unit II Various nanostructures and their applications **13 h**

Bacterial structure relevant to nano-biotechnology, Cubosomes, Dendrimers, DNA Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbon Nanotubes, Nanopores, Nano structured Sillicon, Viruses as nano-particles, nano chemicals and application. Nanomaterials used in various fields and their importance.

Unit III Allied applications of Nanobiotechnology **13 h**

Drug delivery tools through nanotechnology, tumor targeting and other diagnostic applications, nanoparticle-based immobilization assays, quantum dots technology and its application, immuno-nanotechnology. Biosensors and nano-biotechnology, principles used in construction of microelectronic devices, sensors and macro mechanical structures and their functioning. DNA based Nanostructures- DNA-protein nanostructures-Methods-Self assembled DNA nanotubes- Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching Metallization- Properties.

Unit IV Space Microbiology **13 h**

Space Microbiology: An Overview, Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, ESA STONE experiment. Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies.

References

1. Nanobiotechnology- concepts, applications and perspectives, C.M. Niemeyer and C.A. Mirkin, Wiley publishers (2000).
2. Nanobiotechnology of biomimetic membranes, D. Martin, Springer Verlag publishers, (2000).
3. Nanotechnology in Drug Delivery; M.D. Melgardt, A. Porang, Springer-American Association of Pharmaceutical Scientists Press (2009).
4. Bio-Nanotechnology; S.P. Elisabeth, A. Parthasarathy, New Age publishers (2010).
5. Biomedical Nanostructures, K.E. Goonsalves, C.R. Halberstadt, C.T.Laurecin, L.S. Nair, Springer (2011).

Course code	Marine Microbiology	Course type	L	T	P	C	CH
M213SOS312		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have knowledge of aquatic microbiology and their importance.

Course Objectives:

1. Explain the scope and challenges in the field of marine biotechnology
2. Develop better knowledge about marine ecosystems, biodiversity & taxonomy, tools and techniques used and role of marine organisms in biogeochemical cycles
3. Realize the biotechnological importance and to explore the potential of marine organisms for human betterment
4. Demonstrate the various techniques and tools necessary for studying marine microbial diversity and its applications.

Course Outcomes:

By the end of the course the student will be able to

1. Develop knowledge about marine biotechnology, compare the various marine ecosystems and explain the tools and techniques used for sample collection, isolation of micro and macro-organisms and to study their taxonomy.
2. Analyze the importance of marine organisms in various marine pathogenic microbes and their transmission to land
3. Build knowledge on process of drug discovery from marine organisms and various assays and techniques related to it
4. Utilize marine organisms for food, fuel, agriculture, environment, cosmetics, industrial feedstock etc.,

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M213SOS312	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

Unit I Marine Ecology and Diversity **13 h**

Benthic and Pelagic Zone; Photic, dysphotic and aphotic zones- importance and their significance. Biological divisions of the sea- estuaries and backwaters, lagoons, mangroves, coastal waters, inshore, offshore, deep sea/oceanic zone. Sampling, cultivation and taxonomy

of microorganisms and metagenomic approaches. Bacteria, fungi, algae and archaea, Extremophilic microorganisms.

Unit II Marine microbial pathogen **13 h**

Microbial pathogens in marine environment - diversity, sources and detection of pathogens in recreational water, impact of harmful algal blooms, microbial pathogens of seafood. Effect of climatic changes in marine ecosystems.

Unit III Marine Pharmacology **13 h**

Marine derived drugs in preclinical and clinical trials- FDA and EMEA approved marine derived drugs, their use and mode of action. Screening of drugs High-throughput Screening Assays (HTS), Enzyme inhibitory assays, cytotoxicity assay; antimicrobial assay; DNA laddering assay; Apoptosis assay and screening for biologically active molecules from marine microorganisms.

Unit IV Marine microbes for bioprospecting **13 h**

Marine organisms for Biofuels and bioenergy, Bioremediation, Biofouling, Biosurfactants. Marine natural products as cosmetics-cosmeceuticals, algotherapy; Thalassotherapy; Enzymes; food, supplement, nutrition and energy drinks. Marine algae as fish feed, manure and fertilizers. Recent developments in marine microbiology.

References

1. Aquaculture Microbiology and Biotechnology; D. Montet, Ramesh C. Ray, Volume Two 1st Edition, Science Publishers (2011).
2. Introduction to Marine Biology; G. Karleskint, R. Turner, J. Small, 4th Edition, Brooks Cole Publishers (2013).
3. Bioactive Marine Natural Products; D.S. Bhakuni, D.S. Rawat, Springer publishers (2010).
4. Marine Microbiology: Ecology and Applications; Munn and Munn, BIOS Scientific Publisher (2011).

Specialization in Industrial & food Microbiology

Course code	Food Microbiology	Course type	L	T	P	C	CH
M21SOZ301		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have basis of microbial food processing and preservation aspects.

Course Objectives:

1. Understand the principles of microorganisms during various food-processing and preservation steps.
2. Isolation, identification, and enumeration of the most common microorganisms found in specific food products.
3. Recognize specific types of microbial spoilage during various food shelf-life stages.
4. Analyze different foods for presence of hazardous microorganisms using traditional and modern food microbiology technology.

Course Outcomes:

By the end of the course the student will be able to

1. Better understand the factors and sources of food contaminants
2. Describe the situations where improper food handling and storage may lead to the spoilage or contamination of food.
3. Identify desirable microorganisms and their effects in preservation and fermentation.
4. Develop the beneficial microbes in health and other allied food industries.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO 2	PSO 3
M21SOZ301	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

Unit-I History and development of Food microbiology 13 h

History of Microorganisms in Food-developments Common Food borne Bacteria, Role of Molds, and Significance of Microorganisms in Foods. Parameters Affecting Microbial Growth: Intrinsic, Extrinsic. Combined Intrinsic and Extrinsic Parameters-lactic antagonism and hurdle concept.

Unit-II Microorganisms in Foods and methods for detection 13 h

Fresh meat, Processed meat and poultry, Culture, Microscopic, and Sampling Method for detecting microbes, Physical, Chemical methods, Whole animal assays, Immunological methods. Microbial Food Spoilage and Food borne diseases-*Staphylococcal*, *E coli*, Salmonellosis, shigellosis, Listerial infections. Mycotoxins, Aflatoxins Alternaria Toxins, Toxigenic Phytoplankton's and viruses.

Unit-III Food Preservation & Principles of Quality Control 13 h

Chemicals, antibiotics, Radiation, Low and high temperature, High-Pressure Processing Pulsed Electric Fields. Aseptic Packaging, Manothermo, sonication, Microbiological quality standards of food, Government regulatory practices and policies, FDA, HACCP and ISI.

Unit -IV Applications of Food Microbiology 13 h

Applications of Food Microbiology: Beneficial uses of microorganisms in Food Intestinal Beneficial Bacteria-Concept of Prebiotics and Probiotics, Genetically modified foods. Biosensors in foods.

References

1. Microbiology; Adams, R. Martin, M.O. Moss, 3rd Edition, Royal Society of Chemistry, Washington DC, USA (2017).
2. Basic Food Microbiology; Banwart George J.; Elsevier (2010).
3. Food Microbiology: Fundamentals and Frontiers; Dolle, Springer (2010).
4. Fundamentals of Dairy Microbiology; Prajapati, New Age Publishers (2011).

5. Essentials of Food Microbiology; J. Garbult. Arnold International Students Edition (2011).
6. Microbiology of Fermented Foods (Volume II); J.W. Brian, Elsiever Applied Science Publication (2011).

Course code	Food Chemistry and processing	Course type	L	T	P	C	CH
M21SOZ302		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have knowledge macro and micronutrients present in the foods.

Course Objectives:

1. Scientific basis of water and carbohydrates in nature and their interactions.
2. Better understanding of chemistry and importance of the oils and fats.
3. Gain a knowledge about the food processing and preservation technology
4. Understand the various food packaging technology and its mechanisms.

Course Outcome:

By the end of the course the student will be able to

1. Explain the scientific basis of the role of water and carbohydrates with their interactions.
2. Understand the chemistry of oils and fats with its importance.
3. Describe the various food processing and food preservation of different food items.
4. Explore the various packaging materials and process involved in food packing.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ302	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

Unit I Water and Carbohydrates for food **13 h**

Role of water and chemistry of carbohydrates and proteins, Physicochemical properties of water, water weak interactions in Aqueous Systems. Role of water in food, Moisture in foods and determination of moisture. Sources of Carbohydrates and proteins, composition and factors affecting composition of foods, Chemistry of cellulose, starches, other polysaccharides - starch enzymes, Gel formation and starch degradation - Pectic substances, their occurrence, structure, properties and applications in foods., Classification of proteins, physical and chemical properties of proteins, Conformation, functional properties of proteins in foods, hydrolysis of proteins - Changes in proteins during processing - Determination of Proteins.

Unit II Chemistry of Oils and Fats **13 h**

Nomenclature and classification, Physical and chemical properties of fats, rancidity and flavour reversion, processing of oil-bearing materials, refining of oils and fats, fat hydrolysis and trans-esterfication, hydrogenation, Changes in Acyl lipids of foods, Classification and Properties of Unsaponifiable constituents. shortenings and spreads - Emulsions, Definition, surface activity, surface film theory of emulsions, properties and types of emulsions, emulsifying agents, their chemistry during processing - Essential oils, Chemistry of occurrence, Extraction - Terpene oils and their use in foods.

Unit III Food processing and preservations **13 h**

Food processing, preservation Processing and preservation by drying, methods of food concentration: freeze concentration, Ultra-filtration, reverse osmosis, evaporation-Drying, low Temperature, dehydration of fruits, vegetables, milk and animal products. Various methods employed in production of dehydrated commercial products, selection of methods based on characteristics of foods to be produced, advantages and disadvantages. Food irradiation, history and mechanism, the electro-magnetic spectrum, forms of radiant energy. Principles of using electromagnetic radiation in food processing with advantages and disadvantages. Processing and preservation by non-thermal methods. Food additives; Definition, types and functions and safety aspects. Chemical and metal preservatives- type I and type II and permissible limits.

Unit IV Food packaging **13 h**

Objectives and functions of packaging and packaging materials; Types and selection of packaging materials: Paper: pulping, fibrillation and beating, types of papers; Glass: composition, properties, types of closures; Metals as packaging materials: Tinplate containers, tin free steel (TFS), aluminum containers, lacquers; Plastics: types of plastic films, laminated plastic materials, co-extrusion, edible films, biodegradable plastics. Aseptic conditions during packaging.

Reference Books

1. Experimental food science; M.P. Penfield, A.M. Campbell, 3rd Edition, San Diego, CA: Academic press, 2012.
2. Food chemistry; Meyer L.H, CBS Publishers (2006).
3. Food Processing Technology: Principles and Practice, P.J. Fellows, 3rd Edition, Woodhead Publishing (2009).
4. Understanding food: Principles and Preparation; A.C. Brown, Cengage Learning (2018).

Course code	Bioprocess Technology	Course type	L	T	P	C	CH
M21SOZ303		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have knowledge about the fermentation and its products from microbes.

Course Objectives:

1. Gain a knowledge of the basis for upstream process in fermentation technology.
2. Better understand of working principle and design of the bioreactor.
3. Optimize the techniques and formulate the downstream processing of the products.
4. Design the plan for production of industrially important products through fermentation.

Course Outcomes:

By the end of the course the student will be able to

1. Describe the largescale cultivations of microbes for product development.
2. Comprehend the design of microorganisms for fermentation process.
3. Standardize the optimum techniques for the maximum production and separation of fermented products.

4. Apply the knowledge of fermentation for various products from microorganisms.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ303	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

UNIT I Introduction to Bioprocess 13 h

Engineering: Basic concepts of bioprocess engineering- A brief survey of organisms, processes, products. Fermentation- Bacterial, Fungal and Yeast, Biochemistry of fermentation. Industrial strain improvement for better productivity; Fermentation media and Fermentation Process: Natural and synthetic media; Strategies for media formulation, sources of carbon, nitrogen, vitamins and minerals with anti-nutritional factors. Sterilization- Dry and moist heat; Types of fermentation process- submerged, surface and solid state.

UNIT II Bioreactors & fermentation process 13 h

Architecture of advanced bioreactors and their working mechanisms; Design features; Heat and Mass transfer; Specialized bioreactors- design and their functions; Bioreactors- Airlift, Tubular, Membrane, Tower, Fluidized-bed and Packed-bed; photo bioreactors and disposable reactors. Modes of cultivation- batch, fed- batch and continuous fermentation; Kinetics of fermentation, bioprocess control, monitoring of variables- Dissolved oxygen (DO), temperature, agitation, pH and pressure

UNIT III Downstream processing 13 h

Overview of unit operations and their principles, Physical and rheological characteristics of fermentation broths; Pre-treatment-Cell disruption, heating and chemical treatment; solid-liquid separation- filtration and centrifugation; Product isolation- Adsorption, precipitation and

extraction; Purification- Chromatography- Size exclusion, affinity and ion-exchange and HPLC; Finishing operations – Freeze-drying, drying and crystallization.

UNIT IV Microbial fermentation & products **13 h**

Microbiology of cheese and beverage fermentation. Microbiology of fermented milk products (acidophilus milk, yoghurt). Role of microorganisms in beverages – tea and coffee fermentations. Vinegar Fermentation Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases]. Utilization and disposal of dairy by-product - whey. Production of value-added products: Bio preservatives, Biopolymers, Industrial Enzymes, Bio fuels, Cheese, Beer and Single Cell Protein. Fermented meat products. Production of recombinant proteins having therapeutic and diagnostic applications, and vaccines.

Reference Books:

1. Biotechnology; U. Satyanarayana, Books and Allied (P) Ltd (2005).
2. A Textbook on Biotechnology; H.D. Kumar, 2nd Edition, East West Press Pvt. Ltd (2000).
3. Concepts in Biotechnology; D. Balasubramanian et al., Universities Press Pvt. Ltd (2004).
4. Basic Biotechnology; Ratledge, Colin and Bjorn Kristiansen, 2nd Edition, Cambridge University Press (2001).
5. A Textbook of Biotechnology; R.C. Dubey, S. Chand and Co. Ltd (2006).

Course code	Food Microbiology Lab	Course type	L	T	P	C	CH
M21SOZ304		SC	0	0	4	2	4

Prerequisites/Prereading for the course:

Students should have theoretical knowledge of fermented food products and preservation techniques.

Course Objectives:

1. Better understanding of the laboratory design in food safety laboratory.
2. Hands on experience in isolation and identification of microorganisms from various food items.
3. Detection and quantification of microorganisms in food samples.
4. Modern molecular detection technology used in screening the microbes in food samples.

Course Outcomes:

By the end of the course the student will be able to

1. Deep understanding of the laboratory design of food testing laboratory and its importance.
2. Practical handling of the isolation and identification of the microorganisms testing of the food items.
3. Acquire various culture-based methods for detection and quantification of microbes in food samples.
4. Apply modern molecular based methods for detection and quantification microbes in food.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ304	CO1	2	1	1	2	1	1	1	1	1	3	2	1	1
	CO2	1	2	2	1	2	1	1		2	2	1	1	1
	CO3	1	2	2	1	1		1		1	2	1	1	2
	CO4	1	1	2	2	1	1	2	1	1	2	2	2	1

Course Content:

1. Introduction to HACCP and food safety conditions in industry.
2. Sterility tests - Direct inoculation, direct immerse inoculation & membrane filtration.
3. Isolation and identification of microbes from different food source-Canned foods, Meat, Vegetables, Fruits & Milk
4. Microbial limit test & Anaerobic plate count
5. Determination of enteric microorganisms (Petrifilm/VRBA)-Yeast and moulds petrifilm

6. Determination of MRSA from food
7. Bacteriological examination of water by multiple tube fermentation test (MPN)
8. Microbial characterizations techniques-Determination of high osmotic conditions bacteria, Determination of lactic acid producing microbes, sulphate reducing bacteria, nitrifying bacteria, Oxidase listeria rapid test, AOAC Disinfectant test, Koch's postulates for bacterial and fungal pathogen.
9. Determination of toxic substances from food, Preservative efficiency test, MIC and MLC. Bio-burden tests, Organoleptic tests
10. Determination of microbes by PCR

Reference:

1. A Textbook on Biotechnology; H.D. Kumar, 2nd Edition, East West Press Pvt. Ltd (2000).
2. Concepts in Biotechnology; D. Balasubramanian et al., Universities Press Pvt. Ltd (2004).
3. Basic Biotechnology; Ratledge, Colin and Bjorn Kristiansen, 2nd Edition, Cambridge University Press (2001).

Course code	Food chemistry LAB	Course type	L	T	P	C	CH
M21SOZ305		**SC**	**0**	**0**	**4**	**2**	**4**

Prerequisites/Pre reading for the course:

Students should have basic details of food quality and testing requirements.

Course Objective:

1. Gain a knowledge of the various equipment and labware used in the food testing laboratory.
2. Analyze the macro and micronutrients and their roles in the food preparations.
3. Determine the physicochemical properties of the food and their preparations.
4. Qualitative and quantitative analysis of the metabolites in food.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SOZ305	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to

1. Describe and design the food testing laboratory and its requirements.
2. Apply the practical quantification of macro and micronutrients in foods.
3. Exploit the physicochemical properties of the food items
4. Analyze the various metabolites in the food and their preparations.

Course Content:

1. Introduction to equipment and labware used food analysis laboratory**.**
2. Analysis of Macronutrients in food-Determination of fat content, water content, vitamins C and cholesterol
3. Analysis of Micronutrients from food - Sulphate, calcium, phosphates, magnesium, tannins
4. Determination of moisture content, alkalinity and salt
5. Analysis of water-Physical test and chemical test
6. Analysis of milk - Organoleptic test, litmus test, Methylene blue dye reduction test, alcohol test, Adulterants and preservatives, ALP activity
7. Analysis of fruits and vegetables - Determination of salt content, acidity, added sugar and Peroxide activity in fruit content.
8. Analysis of oils and fats-Determination of specific gravity & Polybromide test for mustered oil
9. Determination of food additives - Colour (saffron, curcumin), Flavours, Hemictant (sorbitol), Emulsifiers (lecithin, mono glycerides) and Preservatives (Benzoic acid)
10. Extraction and analysis of secondary metabolites from plants.

References

1. Concepts in Biotechnology; D. Balasubramanian et al., Universities Press Pvt. Ltd (2004).
2. Basic Biotechnology; Ratledge, Colin and Bjorn Kristiansen, 2nd Edition, Cambridge University Press (2001).

Course code	Bioprocess Technology LAB	Course type	L	T	P	C	CH
M21SOZ306		SC	0	0	0	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of fermentation and their products.

Course Objective:

1. Develop skills and competencies in the fermentation process.
2. Practical skills on the downstream processing in the products.
3. Develop various skills to purify the fermented products.
4. Qualitative and quantitative analysis of the various fermented products.

Course Outcome:

By the end of the course the student will be able to

1. Analyze the various skills in extraction of products from fermentation.
2. Apply the practical skills in purification and analyze the products.
3. Exploit the various methods in characterization of the products.
4. Demonstrate the various process of characterization of the products.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ306	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

1. Extraction of enzyme from plant or microbial sources
2. Downstream processes - Crude extraction of enzyme
3. Purification of crude enzyme-Precipitation of enzymes (salt/solvent) and Dialysis
4. Purification by chromatography 0Ion exchange and Gel filtration chromatography
5. Enzyme assay - Total protein estimation by Biuret method and 280 methods
6. Determination of specific activity
7. SDS PAGE
8. Native PAGE and Zymography
9. Immobilization of Enzymes and formulation
10. Production of lactic acid and critic acid and their estimation

References

1. Concepts in Biotechnology; D. Balasubramanian et al., Universities Press Pvt. Ltd (2004).
2. Basic Biotechnology; Ratledge, Colin and Bjorn Kristiansen, 2nd Edition, Cambridge University Press (2001).

Specialization in Agriculture & Environmental Microbiology

Course code	SOIL MICROBIOLOGY	Course type	L	T	P	C	CH
M21SOZ307		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have important roles of microorganisms in the environment and agriculture.

Course Objective:

1. To inculcate student fundamentals of soil microbiology
2. To understand the role of microbes in soil nutrition management
3. To explore the interaction of soil microbiota

4. To exploit the beneficial microflora to increase the fertility of the soil and bioremediation

Course Outcome:

By the end of the course the student will be able to:

1. Acquire the basic knowledge soil microflora.
2. Understand the implications of microflora in biogeochemical cycles.
3. Interpret interaction of microflora in soil ecosystem.
4. Exploit the knowledge of microbes to increase soil fertility and bioremediation.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SOZ307	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

UNIT I Soil microbes **13 h**

Discoveries in soil Microbiology; distribution of microorganisms in soil, Autochthonous, Allochthonous and Zymogenous microbes, quantitative estimation of microorganisms in soil, role of microorganisms in soil fertility; influence of soil and environmental factors on micro flora, moisture, pH, temperature, organic matter, agronomic practices and Soil health card.

UNIT II Biogeochemical cycles **13 h**

Biogeochemical cycles, Carbon cycle, organic matter decomposition, humus formation, Nitrogen cycle - nitrogen fixation, ammonification, nitrification, denitrification, reactions – organisms involved. Nitrogen fixation – symbiotic - root nodulation, non-symbiotic, associative organisms, nitrogenase, hydrogenase, nif gene, nod gene. Microbial transformation of phosphorus, solubilization by phosphobacteria and P- mobilization by mycorrhizal fungi, Microbial transformation of sulphur - sulphur toxicity and sulphur bacteria.

UNIT III Interaction of microbes with soil ecosystem **13 h**

Interaction between soil microbes–Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competition. Interrelationships between soil microbes and plants, Rhizosphere concept, R:S ratio, rhizoplane; spermosphere; phyllosphere, Mycorrhizae-types, Rumen flora, Insects microbial interactions.

UNIT IV Biofertilizer and bioremediation **13 h**

Biofertilizers – *Rhizobium, Azotobacter, Cyanobacteria, Azolla*, and VAM. Biopesticides – *Bacillus thuringiensis, Psuedomonas fluroscence* - 84, *Trichoderma viridae, Bavaria bassiana*, Nuclear Polyheadrosis Virus. Biodegradation – Cellulose, Lignin. Biodetoriation – Wool, Leather. Bioleaching- Copper, Uranium. Biomagnification, Bioremidiation – Degradation of DDT, Atrazine (Xenobiotic Compounds) and Cleanup oil spills – *P. putida*.

REFERENCE BOOKS:

1. Soil Microbiology; N.S. Subba Rao, 4th Edition, Oxford & IBH (2004).
2. Soil Microbiology; R.R. Mishra, 1st Edition, CBS Publishers and distributors, New Delhi (2004).
3. Disease of Crop Plants in India; G. Rangaswami and A. Mahadevan, 4th Edition, PHI Learning (P) Ltd., New Delhi (2002).
4. Agricultural Microbiology; G. Rangaswami and Bagyaraj, 2nd Edition, PHI Learning (P) Ltd., New Delhi (2002).
5. Soil Microbiology; L.T. Robert, 2nd dition, John Wiley and Sons, Inc. New York (2000).
6. Microbial Ecology; R,M, Atlus and Richard Bartha, 4th Edition, An imprint of Addison Wesley Longman Inc, New York (2000).

Course code	PLANT PATHOLOGY	Course type	L	T	P	C	CH
M21SOZ308		**SC**	**4**	**0**	**0**	**4**	**4**

Prerequisites/Pre reading for the course:

Students should have knowledge of plant disease caused by microorganisms.

Course Objective:

1. Understand the fundamentals of plant pathology.
2. Exploit the role of pathogens in disease development.
3. Familiarize with the pathogen interactions with its host.
4. Better understanding of the host defense mechanism against plant pathogens.

Course Outcome:

By the end of the course the student will be able to:

1. Identification of phytopathogens prevailing conditions.
2. Explore the basic knowledge of plant pathogens biology.
3. Comprehend and explain the host-parasite interaction.
4. Design the defence mechanism against plant pathogens to control diseases.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ08	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Contents:

UNIT I Fundamentals of plant pathology **13 h**

Importance and history, definitions and concepts of plant disease. Classification of Plant Diseases. Classification of fungi & bacteria diseases. Phytopathology – Classification of plant diseases, signs, and related terminology. Bacterial disease – Citrus canker, Blight of paddy, Fungal Disease- Red rot of sugarcane, Black stem rust of wheat, Tikka leaf spot, Wilt of cotton, Viral Disease – TMV, Vein clearing disease. Principles and methods of plant disease management, integrated plant disease management. Plant nematodes and its managements.

UNIT II Plant pathobiology **13 h**

Study of plant pathogens and phanerogamic plant parasites. General characters, reproduction, survival and dispersal of important plant pathogens, and symptomatology.

UNIT III Plant-pathogens interactions **13 h**

Host parasite interaction, recognition concept and infection, role of environment and host nutrition on disease development. Disease development-role of enzymes, toxins, growth regulators.

UNIT IV Plant Defence mechanism **13 h**

Defence mechanisms - oxidative burst; Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens. Genetics of resistance; ëRígenes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance. MiRNA and plant defense mechanism.

REFFERENCES

1. Plant Pathology; G.N. Agrios, 5th Edition, Academic Press, New York (2005).
2. Plant Pathology; R.S. Mehrotra and A. Aggarwal, 2nd Edition, Oxford & IBH, New Delhi (2003).
3. Introduction to Principles of Plant Pathology; R.S. Singh, Oxford & IBH, New Delhi (2002).
4. Disease and Insect Resistance in Plants; D.P. Singh, A. Singh, Oxford & IBH, New Delhi (2007).

Course code	Biomass and energy systems	Course type	L	T	P	C	CH
M21SOZ310		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should know about the role of microorganisms as important bioresources.

Course Objective:

1. Understanding of various renewable feedstocks, their availability and attributes for biofuels production.
2. Thorough understanding of the broad concept of generations of biofuel production from biomass.
3. Explore the other low-cost Agri-residues, biowastes, anaerobic digestion and biodiesel production.
4. Analyze and design processes for biofuel production using microbes.

Course Outcome:

By the end of the course the student will be able to

1. Identify and apply potential biomass feedstocks including energy crops.
2. Understand the existing and emerging biomass to energy technologies.
3. Develop a critical thinking about sustainability &resilience.
4. Determine potential solutions for energy needs and problems by incorporating the bioenergy technologies being explored.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PSO 3
M21SOZ310	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

Unit-I Biomass **13 h**

Fundamentals of bioenergy/biofuel; terms and concepts, origin, characteristics, advantages, and dis-advantages, use and cost of different types of biomass resources (renewable feed stocks): agricultural energy crops, agro-horticultural Lignocellulosic residual material and other biogenous waste-production, availability and attributes for bioenergy production.

Unit II Bioenergy production for sustainable environment **13 h**

General principles of the carbon cycle, greenhouse effect and global climate change. Bioeconomy and sustainable bioenergy system, Current and projected future technologies for producing biofuels such as ethanol, biodiesel from oil crops, microbial fuel cells, biohydrogen.

Unit-III Biofuel production **13 h**

Biofuel generations, Pre-treatment technologies, structure and function of lignocellulosic biopolymers, various types of pre-treatment technologies (Physical, mechanical, chemical, biochemical, ionic liquids etcetera) bioconversion of biomass to biofuel; concept of pseudo-lignin and inhibitors, biodiesel production; environmental impacts of biofuel production; concept of Biorefinery, value-added product generation in an integrated approach, processing of biofuel residues-case studies on combined heat and power (CHP)generation. The role of transgenic plants and algae.

Unit- IV Bioenergy Technology **13 h**

Anaerobic digestion process for biogas production, Inoculum-its stability and methane potential, Process microbiology, role of microbes, types and characterization, Effect of pH, temperature, nutrients, organic load ingrate (OLR) and hydraulic retention time (HRT) on biogas production from biogenic waste, Storage and stability of digestate-health and safety issues, Up-gradation of biogas to methane. Life cycle assessment of biofuels and biofuel technologies, India's energy demand and supply management, energy cropping, energy needs for the future: regional prospects.

References

1. Wood and Cellulosic Chemistry; D.N.S. Hon, S. Nobuo, CRC Press (2000).
2. Renewable Energy; B. Sorensen, Academic Press (2010).
3. Sustainable Bioenergy and Bioproducts; G. Kasthurirangan, J.H. van Leeuwen, C. Robert; Springer (2012).
4. Advances in Clean Energy Technology, A.K. Azad, Elsevier (2020).

Course code	Soil Microbiology Lab	Course type	L	T	P	C	CH
M21SOZ310		SC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have knowledge of microbes and their important role in agriculture.

Course Objective:

1. To explore the aspects of microbial culture techniques
2. Formulation and production of biofertilizers
3. To develop mass production of biofertilizers
4. To understand the effect of biofertilizer in the growth of plants

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PS O3
M21SOZ310	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to

1. Apply the knowledge of microbial enumeration and culture techniques.
2. Formulate of liquid and solid biofertilizers
3. Mass production of biofertilizers through industrial fermentations.
4. Evaluate the quality and growth parameters of biofertilizers.

Course Content:

1. Mother culture preparation and preservation techniques
2. Isolation and purification of phosphate solubilizing microorganisms in soil.
3. Mass production of carrier-based formulation of *Azospirillum brasilense, Pseudomonas fluorescens* and *Frateuria aurantia*
4. Industrial mass production of liquid formulation of *Azospirillum spp.*
5. Developing liquid formulations of bio fertilizers to increase shelf life
6. Hands on training of operation of industrial fermenters

7. Concentration of bacterial suspension through centrifugation and spray drying
8. Quality analysis of bio-fertilizers with respect to FCO standards
9. Evaluating effect of bio-fertilizers on crop growth in pot study experiment
10. Bio-fertilizer consortium preparation.

References

1. Agricultural Microbiology; G. Rangaswami and Bagyaraj, 2nd Edition, PHI Learning (P) Ltd., New Delhi (2002).
2. Soil Microbiology; L.T. Robert, 2nd dition, John Wiley and Sons, Inc. New York (2000).
3. Microbial Ecology; R,M, Atlus and Richard Bartha, 4th Edition, An imprint of Addison Wesley Longman Inc, New York (2000).

Course code	Plant Pathology Lab	Course type	L	T	P	C	CH
M21SOZ11		SC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge about various plant pathogens and their diseases.

Course Objective:

1. To enumerate the microbial plant pathogens
2. Characterize the plant pathogens for Kochs' postulates
3. Preservation and screening of antagonistic properties of biocontrol agents
4. Mass production of biocontrol agents.

Course Outcome:

By the end of the course the student will be able to

1. Understand the rules of Kochs' postulates.
2. Identification and characterization of disease-causing plant pathogens
3. Maintenance and production of biocontrol agents
4. Preparations and Formulations of fungicides and their usage in disease management.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ311	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

1. Demonstration of Koch"s postulates for a fungal plant pathogens
2. Screening for antagonism by dual culture method.
3. Collection and preservation of disease specimens.
4. Extraction of Nematodes from soil and plant material.
5. Transmission of plant viruses and study the virus vector relationship.
6. Evaluation of different fungicides against the fungal pathogens.
7. Preparation of Bordeaux mixture. Burgundy mixture and Chaubattia paste and their practical usage in managing the diseases.
8. Growth observations of different fungal bio agents on different growth media and at different pH regimes.
9. Mass production of *Trichoderma viridae, Paecilomyces lilacinus.*
10. Mass production of Entamopathogenic bio- agents viz, *Metarhizium anisopliae, Verticillium lecanni and Beauveria bassiana.*

References

1. Plant Pathology; G.N. Agrios, 5th Edition, Academic Press, New York (2005).
2. Plant Pathology; R.S. Mehrotra and A. Aggarwal, 2nd Edition, Oxford & IBH, New Delhi (2003).
3. Introduction to Principles of Plant Pathology; R.S. Singh, Oxford & IBH, New Delhi (2002).

Course code	Biomass and energy systems Lab	Course type	L	T	P	C	CH
M21SOZ312		HC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of microorganisms for the energy production.

Course Objective:

1. To understand the soil water plant relations
2. Analyze the quality of various sources of water samples
3. Determine organic carbon in soil samples
4. Formulations of micro and macro nutrients for plants.

Course Outcome:

By the end of the course the student will be able to

1. Explore the soil water plant samples and their physio-chemical parameters
2. Apply the knowledge to evaluate the physiochemical parameters of various sources of water samples.
3. Quantitative and qualitative analysis of macro and micro-nutrients
4. Biostatistical data analysis for report preparations.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PSO 3
M21SOZ312	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Content:

1. Collection and processing of soil, water and plant samples from field
2. Analyses of sewage water samples
3. Analyses of irrigation water samples for pH, EC, SO42-
4. Analyses of irrigation water samples for SAR & RSC
5. Analyses of soil samples for pH, EC, OC and macronutrients
6. Analyses of soil samples for micronutrients
7. Analyses of plant samples for macronutrients

8. Analyses of plant samples for micronutrients
9. Analyses of organic manures
10. Soil, Water and Plant analyses reports preparation.

Reference:

1. Agricultural Microbiology; G. Rangaswami and Bagyaraj, 2nd Edition, PHI Learning (P) Ltd., New Delhi (2002).
2. Soil Microbiology; L.T. Robert, 2nd dition, John Wiley and Sons, Inc. New York (2000).

Specialization in Medical and Pharmaceutical Microbiology

Course code	Clinical Microbiology	Course type	L	T	P	C	CH
M21SOZ313		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have basics of diseases caused by various classes of microorganisms.

Course Objective:

1. Gain a knowledge on the bacterial diseases and their importance
2. Acquire the knowledge in virology and diseases caused by viruses
3. Understand the life cycle and reproduction of few important protozoans and fungi.
4. Exploit the cutting-edge technology in handling and analysing the pathogens.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ313	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. Learn about reproduction in bacteria, aspects of bacterial growth and pathogenic nature of bacterial infections.
2. Know the properties, pathogenicity and lab diagnosis of pathogenic viruses.
3. Obtain the information of source, life cycle and diagnosis of pathogenic protozoans and fungi.
4. Explore the various techniques in the diagnosis and detection of diseases.

Course Content:

Unit – I Bacteriology **13 h**

Bacteria-morphology, ultrastructure, nomenclature and classification, growth and nutrition of bacteria, bacterial toxins, antibacterial substances used in the infections and drug resistance in bacteria. Pathogenic bacteria-*Staphylococcus, Micrococcus, Streptococcus, Neisseria, Corynebacterium, Clostridium, Vibrios, Campylobacter, Haemophilus, Mycobacterium, Pseudomonas, Spirochaetes, Chlamydiae, Rickettsiae, Mycoplasma* & *Ureaplasma*.

Unit – II Virology **13 h**

Characteristics and classification of viruses, morphology, virus structure, viral replication, pathogenicity of viruses, bacteriophages, pox viruses, herpes viruses, arboviruses, orthomyxovirus, paramyxoviruses, enteroviruses-polio & other enteric viruses, hepatitis viruses, rabies viruses and HIV. Culturing of viruses in embryonated eggs, experimental animals and cell culture. Identification of viruses-physical and chemical methods of assays (protein nuclei acid, radioactivity traces, electrons microscopy and plaque method).

Unit – III Parasitology and Mycology **13 h**

Protozoan parasites of medical importance-Entamoeba, *Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodium, Toxoplasma* and *Pneumocystis*. Medically important helminths belonging to *Cestodes, Trematodes and Nematodes. Cestodes-Diphyllobothrium, Taenia,*

Echinnococcu and *Hymenolepis*, Nematodes-*Trichuris*, *Trichinella*, *Strongyloides*, *Ancylostoma*, *Ascaris*, *Enterobius* and *Filarial* worms. The morphology and reproduction in fungi, classification of fungi, opportunistic fungi, superficial mycotic infections, subcutaneous mycoses and systemic infections. Laboratory diagnosis of fungal infections and immunity in fungal diseases.

Unit – IV Immunotechnology **13 h**

Brief about the immune system, innate and adaptive immunity, Antigen and antibodies. Complementation system, Antigens and Antibody reactions in vitro Serological testing - agglutination, complement fixation, ELISA, western blotting, immunodiffusion, immunoelectrophoresis, immunofluorescence, immunoprecipitation, radioimmunoassay (RIA), Flow cytometry and serotyping. Molecular diagnostics – molecular basics of diagnostics, Hybridisation technique and PCR based techniques.

Reference books

1. Medical Microbiology; G.F. Brooks, J.S. Butel, and L.N. Ornston, Editors Jawetz, Melnick & Adelberg, 24th Edition, McGraw-Hill (2007).
2. Diagnostic microbiology; A.B. Forbes, D.F. Sahm, A.S. Weissfeld, 10th Edition, Mosby publishers, New York (2001).
3. Principles and practice of infectious diseases; G.L. Mandell, J.E. Bennett, R. Dolin, 7th Edition, Churchill Livingstone, New York (2010).
4. Clinical Microbiology; W.B.Saunders, J. Stokes, G.L. Ridway, M.W.D. Wren, 7th Edition, Edward Arnold – a division of hodder and Stoughton (2013).
5. Immunology; I.R. Tizard, 9th Edition, Elsevier publisher (2013).
6. Molecular Therapeutics: 21st century medicine; P. Greenwell, M. McCulley, 1st Edition, Springer (2008).
7. Molecular Diagnostics; G. Patrinos, W. Ansorage, 1st Edition, Academic Press (2005).

Course code	Medical Biochemistry	Course type	L	T	P	C	CH
M21SOZ314		SC	4	0	0	4	4

Prerequisites/Pre reading for the course:

Students should have basic knowledge of human physiology and biochemical relations.

Course Objective:

1. Acquire the knowledge of source, functions and classification of carbohydrates and lipids.
2. Better understanding of the source, properties and functions associated with the proteins and its clinical relevance.
3. Inculcate the important understanding of disorders associated with the diet and lifestyle.
4. Explore the knowledge of enzymes and their applications in diagnostic purpose.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ314	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. Explore the important functions and disorders associated with carbohydrates and lipids.
2. Acquaint the sources, functions and malnutrition associated with proteins.
3. Depth understanding of healthy diet and role of various sectors in health aspects.
4. Apply and analyze the enzymes in the medical applications and diagnostic purpose.

Course Content:

Unit – I Carbohydrates and Lipids 13 h

Chemistry of carbohydrates and lipids-classifications, properties, classifications. fatty acids types and uses, glycerides, phospholipids, glycolipids, eicosanoids, steroids, cholesterol and lipoproteins. digestion and absorption of carbohydrates, proteins, fats and nucleic acids. physiology and biochemistry of respiration. Detoxification mechanisms generally taking place in human body and body fluids.

Unit – II Proteins and clinical relevance 13 h

Amino acids-classification based on structure, requirement, metabolic fate, solubility, physical properties and chemical properties of amino acids. Proteins-definition, structure, classification and functions. Gout and genetic defects in urate metabolism. Methods employed usually in protein quality evaluation. Nutritional experiments commonly done on laboratory animals. Recent advance techniques used in human nutrition studies

Unit – III Nutrition and Public Health 13 h

Human dietary requirements and deficiency diseases, BMR and BMI, daily nutritional requirements-macro and micronutrients. Malnutrition of proteins and energy, symptoms and diagnosis of nutritional deficiencies-Anaemia, blindness, beriberi, pellagra. Diet, calculation of balanced diet, disorders of protein energy malnutrition. Health determinants and standards, relevance to social aspects, future challenges in public health. Role of public, private and NGO in Health sector.

Unit – IV Principles of diagnostic enzymology 13 h

Introduction to enzymes and nomenclature. Enzyme kinetics and inhibitors, chromogens in brief. Medically important enzymes and factors affecting enzyme levels in blood. Principle, assay and clinical significance of transaminases, creatine kinase, lactate dehydrogenase, phosphatases, isocitrate dehydrogenase, amylase, lipase, trypsin, chymotrypsin, choline esterase, glutamate dehydrogenase, glucose-6-phosphate dehydrogenase and ceruloplasmin.

Reference books

1. Principles of Biochemistry; Lehninger and D.L. Nelson, 6th Edition, Macmillan Publications (2012).
2. Biochemistry; J.M. Berg, J.L. Toymoczko and L. Stryer, 8th Edition, Macmillan Publications (2015).
3. Physical Biology of the Cell; R. Phillips, J. Kondev, J. Theriot, H. Garcia, 2nd Edition, Garland Publishers (2012).
4. Biochemistry; D. Voet and J.G. Voet, 3rd edition, John Wiley and sons (2009).
5. Biochemistry; Garrett and M.G. Charles, 6th Edition, Mary Finch publisher (2013).
6. Biochemistry and Molecular Biology; Elliot, 4th Edition, Oxford University Press (2009).
7. Health & Wellness; G. Edlin and E. Golanty, 10th Edition, Jones & Barlett Publisher (2010).

8. Introduction to Public Health; M.J. Schneider 4th Edition, Jones & Barlett (2014).

Course code	Pharmaceutical Microbiology	Course type	L	T	P	C	CH
M21SOZ315		SC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have basic knowledge of microbes and their importance in pharma industries.

Course Objective:

1. Acquire the knowledge about antibiotics and their various usage in industries
2. Better understanding of the molecular mechanism of action of various antibiotics
3. Exploit the technology for the microbial production of antibiotics and their spoilage
4. Establish the quality assurance and data management in the pharma industries.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ315	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. In-depth understanding about various types of antibiotics and their applications
2. Identify the molecular mechanistic insight of antibiotics actions
3. Utilize the technological advancement for production of antibiotics
4. Explore the quality assurance and quality control aspects involved in industries.

Course Content:

Unit – I Antibiotics and synthetic antimicrobial agents **13 h**

Antibiotics and synthetic antimicrobial agents - Aminoglycosides, β lactams, tetracyclines, ansamycins, macrolid antibiotics. Antifungal antibiotics, antitumor substances. Peptide antibiotics, chloramphenicol, sulphonamides and quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives.

Unit – II Mechanism of action of antibiotics **13 h**

Mechanism of action of antibiotics. Molecular principles of drug targeting. Drug delivery system in gene therapy Bacterial resistance to antibiotics. Mode of action of bacterial killing by quinolinones. Bacterial resistance to quionolinones. Mode of action of non – antibiotic antimicrobial agents.

Unit – III Microbial production and spoilage of pharmaceutical products **13 h**

Microbial contamination and spoilage of pharmaceutical products (sterile injectables, non injectibles, ophthalmic preparations and implants) and their sterilization. Manufacturing procedures and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase). New vaccine technology, DNA and RNA vaccines, synthetic peptide vaccines and multivalent subunit vaccines.

Unit – IV Quality Assurance and Validation **13 h**

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing-chemical and biological indicators. Design and layout of sterile product manufacturing unit. Designing of Microbiology laboratory and safety in microbiology laboratory. Risk management and Risk Mitigations.

Reference books

1. Pharmacology and Pharmacotherapeutics; R.S. Satoskar, N.R. Rege, R.K. Tripathi, S.D. Bhandarkar, 2nd Edition, Popular Prakashan Publishers (2010).
2. Microbiology: Principles & Explorations; J.G. Black, 6th Edition, John Wiley & Sons (2010).

3. Free, Hydrometallurgy: Fundamentals and Applications; L. Michael, 1st Edition, Wiley Publications (2013).
4. Biomining: Theory, Microbes and Industrial Processes (Biotechnology Intelligence Unit); D.E. Rawlings, 1st Edition, Springer publications (2012).
5. The Science and practice of Pharmacy; 20th Edition, B.T. David, B. Paul, Lippincott Williams and Wilkins (2010).

Course code		Course type	L	T	P	C	CH
M21SOZ316	**Clinical Microbiology LAB**	**SC**	**0**	**0**	**4**	**2**	**4**

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge about physiological functions of host during disease conditions.

Course Objective:

1. In-depth understanding the establishment setup of the clinical microbiology laboratory and good lab practices.
2. Hands on experiences in handling and preservations of the laboratory specimens.
3. Exposure to the various techniques in molecular diagnostic protocols.
4. Explore the basics of the molecular diagnostic laboratory.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ316	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. Better understanding of the clinical microbiology laboratory setup.
2. Exploit the handling of the clinical specimens for diagnostics.
3. Explore the techniques involved in the pre-processing of molecular diagnostics.
4. Exploit the various advanced molecular techniques for diagnostics and research.

Course Content:

1. Laboratory safety: Fire, chemical, radiation, handling of biological specimens, waste, Disposal regulations and workplace hazardous.
2. Specimen collection, identification, transport, delivery and preservation.
3. ELISA technique-direct.
4. Indirect ELISA and analyses.
5. PCR for virus detection.
6. RT-PCR quantitation of viruses.
7. Separation of serum from blood and preparation for further testing.
8. Isolation of DNA followed by analysis through agarose gel electrophoresis.
9. Isolation of RNA followed by analysis through formaldehyde agarose gel electrophoresis.
10. Quality and quantitative analysis of DNA and RNA by spectrophotometer.

Reference

1. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications; L. Buchingham and M.L. Flawsm, 1st Edition, FA Davis Company, Philadelphia, USA (2007).
2. Immunology; J. Kuby, J. Owen, J. Punt, S. Stranford; 7th Edition, W.H. Freeman and Company (2013).
3. Essential Immunology, P.J. Delves, S.J. Martin, D.R. Burton, I.M. Roitt, 12th Edition, ELBS, Blackwell Scientific Publishers, London (2011).

Course code	Medical Biochemistry LAB	Course type	L	T	P	C	CH
M21SOZ317		HC	0	0	4	2	4

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of biochemical aspects in human abnormal conditions**.**

Course Objective:

1. Understand the various protein extraction and analysis techniques
2. Establishment protocols and setup of Medical Biochemistry lab.
3. Hands-on experience in analysis of the cells and sub-cellular parts
4. Explore various molecular mechanism of microRNA studies.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PS O1	PS O2	PS O3
M21SOZ317	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2
	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. Better understanding of the biochemical methods in protein extraction and analysis.
2. Hand-on experience in advance methods of flowcytometry and microRNA.
3. Standardize the protocols for the medical biochemistry lab.
4. Exploit the molecular and biochemical analysis methods in industries and research.

Course Content:

1. Tissue homogenization and cell disruption-Cell fractionation methods by ultra and gradient centrifugation
2. Protein extraction and column purification from the samples and its spectrophotometer analysis.
3. Flowcytometric analysis of blood cells.
4. Gelatin zymographic analysis.
5. SDS PAGE for isozymes detection.

6. Western blotting analysis for the gene products-biomarker analysis.
7. Preparation of immunohistochemistry samples and confocal/fluorescent microscopy.
8. Preparation of samples for electron microscopy and demonstration of imaging.
9. Estimation of LDH and phosphatase levels in blood with clinical significance.
10. Isolation and identification of miRNA.

Reference books

1. Analytical techniques in Biochemistry and molecular Biology; R. Katoch, Springer (2011)
2. Basic Methods for the Biochemical Lab; M. Holtzhaue, Springer (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology; K. Wilson and J. Walker, 7th Edition, Cambridge University Press (2010).
4. Experiments in Applied Microbiology; S. Singer Academic Press (2001).

Course code	Pharmaceutical Microbiology LAB	Course type	L	T	P	C	CH
M21SOZ318		**HC**	**0**	**0**	**4**	**2**	**4**

Prerequisites/Pre reading for the course:

Students should have theoretical knowledge of microbial quality control in pharmaceutical industries.

Course Objective:

1. Understand the microbiological methods for determination of antibiotics.
2. Practical explore in the antimicrobial sensitivity assay for antibiotics.
3. Aid in conducting the toxicity studies in the cell culture.
4. Determine the microbial spoilage and load in the pharmaceutical products.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PSO 2	PSO 3
M21SOZ318	CO1	3	3	3	2	1		2	2		3	3	3	2
	CO2	3	2	3	1	1		2	2		3	3	3	2
	CO3	3	2	3	1	2		2	2		3	3	3	2

	CO4	3	3	3	2	1		2	2		3	3	3	2

Course Outcome:

By the end of the course the student will be able to:

1. Determine the microbial methods in the antibiotic's studies.
2. Exploit the antimicrobial sensitivity assay for quality analysis and research.
3. Assist and analyze the toxicity studies in the cell cultures.
4. Analyze the various microbial spoilage in the pharmaceutical products.

Course Content:

1. Microbiological methods for the determination of griseofulvin/streptomycin.
2. Bioassay of chloramphenicol by plate assay method.
3. Antimicrobial susceptibility testing by broth dilution method.
4. To determine MIC, LD50 of Beta-lactam/aminoglycoside/ tetracycline.
5. Sterility testing by *Bacillus stearothermophilus*
6. Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations).
7. Separation of mononuclear cells by Ficoll-Hypaque and cell viability by MTT assay.
8. Identification of various types of blood cells by blood smear and microscopy.
9. Isolation of peripheral blood cells and viability testing by live-dead staining method.
10. Counting and viability assessment of animal cells by direct microscopic methods.

Reference

1. Microbiological methods; C.H. Collins, M.L. Tatrica and J.M. Grange, 8th Edition, Hodder Arnold publishers (2004).
2. Biopharmaceuticals: Biochemistry and Biotechnology; G. Walsh, 2nd Edition, John Wiley & Sons, Wiley Publications (2013).
3. Biotechnology & Biopharmaceuticals Transforming Proteins and Genes into Drugs; R.J.Y. Ho, 2nd Edition, Wiley-Blackwell (2013).

FOURTH SEMESTER

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
M21SO0401	**MAJOR PROJECT AND DISSERTATION**	HC	0	0	10	10	10

Course Objective:

To carry out the research under the guidance of supervisor and in the process learn the techniques of research.

Course Outcome:

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

1. Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
2. Demonstrate the skill sets acquired and employ the knowledge of current information in the domain.
3. Apply technological tools and techniques specific to the professional field of study.

4. Acquire real time exposure to the systematic execution of research components and methodology.

Mapping of Course Outcomes with Program Outcomes

Course Code	POS / COS	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PSO 1	PS O2	PS O3
M21SO0401	CO1	2	3		3							3	2	2
	CO2	2	2	3	3	3	3					2	3	2
	CO3	2	2	3	3	3	3		3	3	3	3	3	3
	CO4	3	3	3	3	3	3	3	3	3	3	3	3	3

Course Content:

Each student individually select the topic of research preferably from any area of core domains of microbiology and work under the guidance of allocated faculty member. The project shall preferably be application oriented or industry need based that could be useful to the society. In case of industry need based project or R & D project the student may opt co-supervisor from the concerned industry / research institution as the case may be. The student will have to make a preliminary survey of research done in broad area of his/her area of interest and decide on the topic in consultation with his/her supervisor(s). The project work floated should be completed within 6-months and project report has to be submitted within the stipulated date by the University/ within 6-months whichever is earlier. The student has to meet the concerned supervisor(s) frequently to seek guidance and also to produce the progress of the work being carried out. The student should also submit progress report during 5th week and 10th week of the beginning of the semester and final draft report with findings by 14th week. After the completion of the project the student shall submit project report in the form of dissertation on a specified date by the School.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
M21SOON01	**SWAYAM/ MOOC -1**	SC	0	0	0	2	0

Course outcomes

1. Enhance the conceptual knowledge and ensure academic achievement in the subject domain offered through the e learning.
2. Gain additional expertise gained in the process of e-learning.

3. Acquire intellectual skills such as domain-specific and generic abilities involved in reasoning, comprehension and thinking abilities.
4. Inculcate the problem-solving, and decision-making skills related to the subject domain.

Mapping of Course Outcomes with Programme Outcomes

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

MOOC / SWAYAM Online Courses: Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

A student shall register and successfully complete any of the courses available on SWAYAM / MOOC. Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The duration and credits of the course shall vary depending upon the agency offering MOOC / SWAYAM courses. The student should submit the certificate issued by the agency offering SWAYAM / MOOC courses to the coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

Course code	Course Title	HC/ SC/ OE	L	T	P	C	Hrs./ Wk.
M21SOON01	**SWAYAM/ MOOC -2**	SC	0	0	0	2	0

Course outcomes

1. Enhance the conceptual knowledge and ensure academic achievement in the subject domain offered through the e learning.
2. Gain additional expertise gained in the process of e-learning.
3. Acquire intellectual skills such as domain-specific and generic abilities involved in reasoning, comprehension and thinking abilities.
4. Inculcate the problem-solving, and decision-making skills related to the subject domain.

Mapping of Course Outcomes with Programme Outcomes

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

MOOC / SWAYAM Online Courses: Globally, MOOC (Massive Open Online Course) platforms are gaining much popularity. Considering the popularity and relevance of MOOCs, Government of India has also launched an indigenous platform, SWAYAM. SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) is basically an integrated MOOCs platform for distance education that is aimed at offering all the courses from school level (Class IX) to post-graduation level. The platform has been developed collaboratively by MHRD (Ministry of Human Resource Development) and AICTE (All India Council for Technical Education) with the help of Microsoft and is capable of hosting 2,000 courses.

A student shall register and successfully complete any of the courses available on SWAYAM / MOOC. Student shall inform the MOOC/SWAYAM coordinator of the school about the course to which he/she has enrolled. The duration and credits of the course shall vary depending upon the agency offering MOOC / SWAYAM courses. The student should submit the certificate issued by the agency offering SWAYAM / MOOC courses to the coordinator of the school, the grades obtained in the course shall be forwarded to concerned authority of the University.

CAREER OPPORTUNITIES

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

1. Willingness to learn
2. Self-motivation
3. Team work
4. Communication skills and application of these skills to real scenarios
5. Requirement of gathering, design and analysis, development and testing skills
6. Analytical and Technical skills
7. Computer skills
8. Internet searching skills
9. Information consolidation and presentation skills
10. Role play
11. Group discussion, and so on

REVA University therefore, has given utmost importance to develop these skills through variety of training programs and such other activities that induce the said skills among all students. A full-fledged Career Counselling and Placement division, namely Career Development Centre (CDC) headed by well experienced senior Professor and Dean and

supported by dynamic trainers, counsellors and placement officers and other efficient supportive team does handle all aspects of Internships and placements for the students of REVA University. The prime objective of the CDC is to liaison between REVA graduating students and industries by providing a common platform where the prospective employer companies can identify suitable candidates for placement in their respective organization. The CDC organizes pre-placement training by professionals and also arranges expert talks to our students. It facilitates students to career guidance and improve their employability. In addition, CDC forms teams to perform mock interviews. It makes you to enjoy working with such teams and learn many things apart from working together in a team. It also makes you to participate in various student clubs which helps in developing team culture, variety of job skills and overall personality.

The need of the hour in the field of Microbiology and Life Sciences is not only knowledge in the subject, but also the skills to do the job proficiently, team spirit and a flavour of innovation. This kept in focus, the CDC has designed the training process, which will commence from second semester along with the curriculum. Special coaching in personality development, career building, English proficiency, reasoning, puzzles, and communication skills to every student of REVA University is given with utmost care. The process involves continuous training and monitoring the students to develop their soft skills including interpersonal skills that will fetch them a job of repute in the area of his / her interest and march forward to make better career. The School of Chemical and Biological sciences also has emphasised subject based skill training through lab practice, internship, project work, industry interaction and many such skilling techniques. The students during their day to day studies are made to practice these skill techniques as these are inbuilt in the course curriculum. Concerned teachers also continuously guide and monitor the progress of students.

The University has also established University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director to facilitate skill related training to REVA students and other unemployed students around REVA campus. The centre conducts variety of skill development programs to students to suite to their career opportunities. Through this skill development centre the students shall compulsorily complete at least two skill / certification based programs before the completion of their degree. The University has collaborations with Industries, Corporate training organizations, research institutions and Government agencies like NSDC (National Skill Development Corporation) to conduct certification programs. REVA

University has been recognised as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal VikasYojana. The University has also signed MOU's with Multi-National Companies, research institutions, and universities abroad to facilitate greater opportunities of employability, students' exchange programs for higher learning and for conducting certification programs.

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SCHOOL OF MANAGEMENT STUDIES

BBA (Industry Integrated)

HAND BOOK

BATCH: 2020-23

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Rukmini Educational
Charitable Trust

Chancellor's Message

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

- Nelson Mandela.

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

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

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

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

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

Dr. P. Shyama Raju

The Founder and Hon'ble Chancellor, REVA University

Vice-Chancellor's Message

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

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

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

At REVA University, research, consultancy and innovation are regarded as our pillars of success. Most of the faculty members of the University are involved in research by attracting funded projects from various research level organizations like DST, VGST, DBT, DRDO, AICTE and industries. The outcome of the

research is passed on to students through live projects from industries. The entrepreneurial zeal of the students is encouraged and nurtured through EDPs and EACs.

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

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

Welcome to the portals of REVA University!

Dr. S. Y. Kulkarni

Vice-Chancellor, REVA University

Director's Message

Today, as you prepare to join our campus and start the next chapter of your lives, in what can only be described as an increasingly divided and fast-shifting world, I want to offer some thoughts specific to the challenging times in which we find ourselves. Your responsibilities as Management student to lead businesses are more important today than ever. You will be graduating into a world in which trust and faith in business has declined significantly, and you have to develop the personality reflecting honesty and Ethics.

As Business Student- leaders, part of your responsibility is to rebuild this trust between business and society. My hope is that the many discussions you will have, in courses as varied as Leadership and Corporate Accountability and Finance, Ethical Management, Governance, HRM, HR, have given you tools and perspectives that will serve as a guide to you in the future. I hope you will develop, and will continue to develop, both the competence and character of true leadership. You will need both to fulfill your responsibility to rebuild trust. The way you can do so is by creating shared prosperity; in essence, by ensuring that you create value for others before you claim value for yourself.

You can exercise your responsibility to help rebuild trust not only by the big decisions you make while leading organizations, but also by the smaller interactions you have every day. Business Leaders—rightly—are scrutinized more carefully than others, so even small signs of arrogance, excessive pride, or self-interest will be magnified. Hold yourself to a higher standard.

Many of our alumni currently lead some of the most admired and most valuable companies on the planet. They have been crucial to the creation and evolution of entire industries, including management consulting, mutual funds, private equity, venture capital, and social entrepreneurship, HR, Marketing, Entrepreneurship, and the like.

If you want your lives to have that kind of impact, you must REACH, that is stretch for things in life that seem just a bit outside your grasp, just a bit audacious. When we reach, we take a risk that has the potential to fundamentally shift the trajectory of our lives and our organizations. We develop three types of behaviour in this school: 1. Modesty; 2. Honesty; and 3. Winning Attitude, focusing on knowledge, skills, and competency.

Often our biggest sense of accomplishment comes not when we reach for ourselves, but when we reach out on behalf of others. I experience this most often when I deal with our distinguished alumni who give

back to so many causes. Today you join a group of alumni who are distinguished not only as leaders, but as philanthropists and energetic civic participants—people who lead and fund countless non-profits and philanthropies. It's a privilege for me to spend time with these people, and we ask that you RESPECT the people who are most important in your lives, and everyone with whom you interact along your road to leadership. Remember that nothing can be accomplished without the help of everyone in REVA University.

The Curriculum caters to and has relevance to local, regional, national, and global development needs. A maximum number of courses are integrated with cross-cutting issues with relevant to professional ethics, gender, human values, environment and sustainability.

Lastly, show respect on a daily basis to everyone you interact with: your co-students. As students, you will often get more credit than you deserve; be sure to share this credit by giving respect to all who contribute to any success. Let me in that spirit take a moment to thanks your parents, guardian who have collectively helped to educate you and bring you to this wonderful moment of Management World.

As you begin this exciting journey, I wish you all the best.

Prof. Shubha A
Director
School of Commerce & Management Studies

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RUKMINI EDUCATIONAL CHARITABLE TRUST

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

Every great human enterprise is powered by the vision of one or more extraordinary individuals and is sustained by the people who derive their motivation from the founders. The Chairman of the Trust is Dr. P. Shyama Raju, a developer and builder of repute, a captain of the industry in his own right and the Chairman and Managing Director of the DivyaSree Group of companies. The idea of creating these top-notch educational institutions was born of the philanthropic instincts of Dr. P. 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 M. Phil and PhD degrees. REVA has well qualified experienced teaching faculty of whom majority are doctorates. The faculty is supported by committed administrative and technical staff. Over 14,000 students study various courses across REVA's three campuses equipped with exemplary state-of-the-art infrastructure and conductive 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 dated 7th February, 2013. The University is recognised by UGC under Sec 2 (f) and empowered under Sec.22 of the UGC Act, 1956 to award degrees in any branch of knowledge. The University is a Member of Association of Indian Universities, New Delhi. The main objective of the University is to prepare students with knowledge, wisdom and patriotism to face the global challenges and become the top leaders of the country and the globe in different fields.

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

The University is presently offering 27 Post Graduate Degree programs, 29 Degree and PG Degree programs in various branches of studies and has 15000+ students studying in various branches of knowledge at graduate and post graduate level and 494 Scholars pursuing research leading to PhD in 18 disciplines. It has 900+ well qualified, experienced and committed faculty members of whom majority are doctorates in their respective areas and most of them are guiding students pursuing research leading to PhD.

The programs being offered by the REVA University are well planned and designed after detailed study with emphasis with knowledge assimilation, applications, global job market and their social relevance. Highly qualified, experienced faculty and scholars from reputed universities / institutions, experts from industries and business sectors have contributed in preparing the scheme of instruction and detailed curricula for this program. Greater emphasis on

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

REVA University recognizing the fact that research, development and innovation are the important functions of any university has established an independent Research and Innovation division headed by a senior professor as Dean of Research and Innovation. This division facilitates all faculty members and research scholars to undertake innovative research projects in engineering, science & technology and other areas of study. The interdisciplinary-multidisciplinary research is given the top most priority. The division continuously liaisons between various funding agencies, R&D Institutions, Industries and faculty members of REVA University to facilitate undertaking innovative projects. It encourages student research projects by forming different research groups under the guidance of senior faculty members. Some of the core areas of research wherein our young faculty members are working include Data Mining, Cloud Computing, Image Processing, Network Security, VLSI and Embedded Systems, Wireless 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, Nano Tribology, Fuel Mechanics, Operation Research, Graph theory, Strategic Leadership and Innovative Entrepreneurship, Functional Development Management, Resource Management and

Sustainable Development, Cyber Security, General Studies, Feminism, Computer Assisted Language Teaching, Culture Studies etc.

The REVA University has also given utmost importance to develop the much-required skills through variety of training programs, industrial practice, case studies and such other activities that induce the said skills among all students. A full-fledged Career Development and Placement (CDC) department with world class infrastructure, headed by a dynamic experienced Professor & Dean, and supported by well experienced Trainers, Counsellors and Placement Officers. The University also has University-Industry Interaction and Skill Development Centre headed by a Senior Professor & Director facilitating skill related training to REVA students and other unemployed students. The University has been recognized as a Centre of Skill Development and Training by NSDC (National Skill Development Corporation) under Pradhan Mantri Kaushal Vikas Yojana. The Centre conducts several add-on courses in challenging areas of development. It is always active in facilitating student's variety of Skill Development Training programs.

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

Instruments, Nokia University Relations, EMC2, VMware, SAP, Apollo etc, to facilitate student exchange and teacher–scholar exchange programs and conduct training programs. These collaborations with foreign universities also facilitate students to study some of the programs partly in REVA University and partly in foreign university, viz, M.S in Computer Science one year in REVA University and the next year in the University of Alabama, Huntsville, USA.

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

To motivate the youth and transform them to become innovative entrepreneurs, successful leaders of tomorrow and committed citizens of the country, REVA organizes interaction between

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

As a part of our effort in motivating and inspiring youth of today, REVA University also has instituted awards and prizes to recognize the services of teachers, researchers, scientists, entrepreneurs, social workers and such others who have contributed richly for the development of the society and progress of the country. One of such awards instituted by REVA University is 'Life Time Achievement Award' to be awarded to successful personalities who have made mark in their field of work. This award is presented on occasion of the "Founders' Day Celebration" of REVA University on 6th January of every year in presence of dignitaries, faculty members and students gathering. The first "REVA Life Time Achievement Award" for the year 2015 has been awarded to Shri. Kiran Kumar, Chairman ISRO, followed by Shri. Shekhar Gupta, renowned Journalist for the year 2016, Dr K J Yesudas, renowned play back singer for the year 2017. REVA also introduced "REVA Award of Excellence" in the year 2017 and the first Awardee of this prestigious award is Shri Ramesh Aravind, Actor, Producer, Director, Screen Writer and Speaker.

REVA organizes 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 recognized by distributing awards and prizes. The founders have also instituted medals and prizes for sports achievers every year. The physical education department conducts regular yoga classes every day to students, faculty members, administrative staff and their family members and organizes yoga camps for villagers around.

Within short span of time, REVA University has been recognised as a fast-growing university imparting quality higher education to the youth of the country and received many awards, ranks, and accolades from various agencies, institutions at national and international level. These include: Asia's Greatest Brand and Leaders, by Asia One, National Award of Leadership Excellence, by ASSOCHAM India, Most promising University, by EPSI, Promising Upcoming Private University in the Country, by The Economic Times, Best University of India (South), by Dialogue India, Gold Brand by QS University Ranking, placed under 151-200 band by NIRF, 6TH Rank in the Super Excellence category by GHRDC, 6TH Rank in All India Law School Survey, ranked among Top 30 Best B Schools by Business World, India's Best Law Institution by Careers 360, to mention a few.

Advisory Board

Sl. No.	Name of Members
1	**Dr. B. Mahadevan** Professor, IIM – Bangalore, Bannerghatta Road, Bangalore Phone: +91-80-26993275 E-mail: b.mahadevan@iimb.ernet.in
2	**Dr S Nayana Tara** Professor IIM- Bangalore, Bannerghatta Road, Bangalore Phone: +91-80-26993082 E-mail: tara@iimb.ernet.in
3	**Dr. D N S Kumar** Director (Research) Christ University, Bangalore (O) 40129018(M) 8880919142
4	**Dr. M. S. Moodithaya** Registrar, Nitte University Derlakatte, Mangalore (M) 9845370401
5	**Dr. A. H. Chachadi** Retired Professor, Karnataka University, Dharwad (M) 9448631340 (R) (0836) 2742820
6	**Dr. Teerooven Soobaroyen** School of Management, Faculty of Business and Law University of Southampton, Highfield, Southampton, SO17 1BJ, UK Email: t.soobaroyen@soton.ac.uk
7	**Dr Collins Ntim** - BSc, MSc, MRes, PhD, PGCTHE, FHEA. Professor of Accounting & Finance, Department of Accountancy University of Huddersfield, UK Email: c.ntim@hud.ac.uk
8	**Dr. Shanthi S K** **C**hair Professor - Union Bank Center for Banking Excellence, Greta Lakes University, Chennai--6303102 Email: shanthi.sk@greatlakes.edu.in
9	**Mr. Nagaraj Kulkarni** Director, Compgence Bangalore. Mobile: 9980540426

	Email:- nagarjkulkarni@compegence.com

ABOUT SCHOOL OF MANAGEMENT STUDIES

The School of Management Studies offers BBA (Industry Integrated), BBA (Honours), BBA (Entrepreneurship) and MBA Programs. It also facilitates research leading to Doctoral degree. The BBA (Industry Integrated), BBA (Honours), BBA (Entrepreneurship) and MBA are designed to provide adequate scope students to enter into wide range of business spheres, entrepreneurship, and reduce the widening gap between Industries – Academia. The BBA (Industry Integrated) degree offered by this school enriches the students' knowledge horizon and enables them to work in different national and multinational organizations and face the global challenges arising there from. It not only aims at imparting knowledge and skills in different areas of management and accounting, but also provides inputs necessary for the overall development of the personality of the students. It prepares student's right from the inception to get equipped with required skills through continuous training programs that adopt various methods of learning - case studies, group discussions / analysis, simulation, games, debates, seminars, quiz and the like. The students are groomed with the right exposure to the practical events in the global market milieu.

The Master's degree in Management Studies not only provides adequate scope to enter into wide range of business spheres, and entrepreneurship but also teaching and research fields in different educational / research institutions. This program aims at imparting knowledge and skills in different areas of management, finance, accounting, marketing, human resource, banking and insurance, operations management and actuarial management. It further provides inputs necessary for the overall development of the personality of the students. It induces students' right from the beginning to get equipped with required skills through case studies, group discussions / analysis, simulation, games, debates, seminars, quiz and the like. The students are groomed with the right exposure to the practical environment through a semester long project work. The program also inculcates research culture and entrepreneurship.

The programs offered by REVA University are well planned and designed after detailed study with emphasis on 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 schemes of instruction and curriculum for these programs.

Vision

- To produce world class management experts through excellent teaching and research so as to offer professional services at National and International levels.

Mission

- To provide high-standard, forward-looking, morally, socially and ethically responsive, coherent, interdisciplinary and career-oriented programs in a dynamic global education environment.
- To contribute to the enrichment and dissemination of knowledge through theoretical, applied and problem-oriented research for the benefit of students, faculty, and society in general;
- To serve the community by undertaking customer-oriented research, providing training and professional consultation for business, industry and government and pursue research in partnership with business and governmental organizations.

Values

- Excellence in all our academic and research endeavors
- Dedication and service to our stakeholders
- Leadership through innovation
- Accountability and transparency
- Creating conducive academic environment with service motto

- Integrity and intellectual honesty
- Ethical and moral behaviour Freedom of thought and expression
- Adaptability to the change
- Team-work

Program Educational Objectives (PEO)

PEO 1: Graduate after successful completion of the Program will be able to take up career in Public, Private and Corporate organizations.

PEO 2: Graduates after completion of the program will be able to work with diverse teams and are expected to take better decisions in complex situations.

PEO 3: Graduates will be able to incorporate social, ethical and moral principles in professional and personal life.

Program Specific Outcomes (PSO)

PSO	Description
PSO1	Demonstrate understanding of the basic concepts and theoretical knowledge used in the different commerce and business-related areas.
PSO2	Develop ideas for start –ups through knowledge and skills developed during the course of the degree.
PSO3	Apply different tools and techniques in solving problems related to Business.

Program Outcomes

The School of Management studies was established in the year 2014 and since then the School has defined Program Outcomes for the courses offered during the Board of Studies meeting. Based on the advice and suggestions of the BOS, EIGHT Program Outcomes have been formulated, keeping in view the Vision, Mission and Program Educational Objectives.

Description of the Program Outcomes

PO	Description
PO1	Communicate effectively with various stake - holders
PO2	Foster Analytical and critical thinking abilities for data – based decision making
PO3	Ability to develop Value based leadership Ability
PO4	Ability to understand, analyze and communicate global, economic, legal

	and ethical aspects of business
PO5	Engage in Research and apply statistical tools and techniques for Problem solving and decision making.
PO6	Enhance skills required for a particular domain by integrating practical and theoretical knowledge
PO7	Gain knowledge through inter- disciplinary and Multi – disciplinary courses
PO8	Apply knowledge of Theory and Practices to solve business problems

School of Management Studies

Course Content of UG Programs-2020-21

Bachelor Business Administration (INDUSTRY INTEGRATED) (BBA (II)

(Effective from Academic Year 2020-21)

SCHEME OF INSTRUCTION

Sl. No	Course Code	Title of the Course	HC/SC/ SE/CC	Credit Pattern			
				L	T	P	Total
FIRST SEMESTER							
1	B20BB1010	Communicative English	CC	2	1	0	3
2	B20BB1021	Language – II: Kannada	CC	2	1	0	3
3	B20BB1022	Language – II: Hindi	CC				
4	B20BB1023	Language – II: Additional English	CC				
5	B20BB1030	Fundamentals of Accounting	HC	3	0	1	4
6	B20BB1040	Economics for Business	SC	2	1	0	3
7	B20BB1050	Introduction to Management	SC	2	1	0	3
8	B20BB1060	Business Organization and Environment	SC	2	1	0	3
9	B20BB1070	Indian Constitution and Human Rights	FC	0	0	0	0
10	B20BB1080	Skill Development Course	RULO	0	0	0	0
Total Credits							**19**
SECOND SEMESTER							
1	B20BB2010	Business Communication	SC	2	1	0	3
2	B20BB2021	Language – II: Kannada	CC	2	1	0	3
3	B20BB2022	Language – II: Hindi	CC				
4	B20BB2023	Language – II: Additional English	CC				
5	B20BB2030	Statistics for Management	HC	3	0	1	4
6	B20BB2040	Corporate Accounting	SC	2	0	1	3
7	B20BB2050	Marketing Management	SC	2	1	0	3
8	B20BB2060	Organizational Behavior	SC	2	1	0	3
9	B20BB2070	Environment and Public Health	FC	0	0	0	0
10	B20BB2080	Skill Development Course	RULO	0	0	0	0

Total Credits							**19**
THIRD SEMESTER							
1	B20BB3011	Language – II: Kannada	CC	1	1	0	2
2	B20BB3012	Language – II: Hindi					
3	B20BB3013	Language – II: Additional English					
4	B20BB3020	Cost Accounting	SC	2	0	1	3
5	B20BB3030	Financial Management	HC	3	0	1	4
6	B20BB3040	Service Sector Management	HC	3	1	0	4
7	B20BB3050	Business Ethics and Corporate Governance	SC	2	1	0	3
8	B20BB3060	Indian Financial System	SC	2	1	0	3
9	B20BB3070	Open Elective - Career Planning and Development	OE	3	1	0	4
10	B20BB3080	Skill Development Course	RULO	0	0	0	0
Total Credits							**23**
FOURTH SEMESTER							
1	B20BB4011	Language – II: Kannada	CC	1	1	0	2
2	B20BB4012	Language – II: Hindi					
3	B20BB4013	Language – II: Additional English					
4	B20BB4020	New Venture Planning	HC	3	1	0	4
5	B20BB4030	Business Law	HC	3	1	0	4
6	B20BB4040	Production and Operation Management	HC	3	0	1	4
7	B20BB4050	International Business	SC	2	1	0	3
8	B20BB4060	Skill Development Course	RULO	0	0	0	0
Specializations (Soft Core Courses (SC)); * Choose any ONE of the following specializations							
I.	**Finance**						
II.	**Human Resource**						
III.	**Marketing**						
IV.	**International Business**						
I.	**Finance Specialization**						
7	B20BB4111	Corporate Financial Policy	SC	2	1	0	3
	B20BB4112	International Finance	SC	2	1	0	3
II.	**Human Resource Specialization**						
8	B20BB4211	Strategic Human Resource Management	SC	2	1	0	3
	B20BB4212	Compensation Management	SC	2	1	0	3
III.	**Marketing Specialization**						

9	B20BB4311	Retail Management	SC	2	1	0	3
	B20BB4312	Consumer behavior	SC	2	1	0	3
IV. International Business Specialization.							
10	B20BB4411	International Trade and Policy Framework	SC	2	1	0	3
	B20BB4412	Foreign Exchange Management	SC	2	1	0	3
Total Credits							**23**
FIFTH SEMESTER							
1	B20BB5010	Income Tax	HC	3	0	1	4
2	B20BB5020	Management Accounting	HC	3	0	1	4
3	B20BB5030	Business Research Methodology	HC	3	0	1	4
4	B20BB5040	Skill Development Course	RULO	0	0	0	0
Specializations (Soft Core Courses (SC)); Choose any ONE of the following specializations							
I. Finance Specialization							
6	B20BB5111	Financial Markets and Services	SC	2	1	0	3
	B20BB5112	Security Analysis and Portfolio Management	SC	2	1	0	3
II. Human Resource Specialization							
7	B20BB5211	Employee welfare & social security	SC	2	1	0	3
	B20BB5212	Organizational change & Development	SC	2	1	0	3
III. Marketing Specialization							
8	B20BB5311	International Marketing	SC	2	1	0	3
	B20BB5312	Advertising	SC	2	1	0	3
IV. International Business Specialization							
9	B20BB5411	International Business Environment	SC	2	1	0	3
	B20BB5412	Global Operations and Logistics	SC	2	1	0	3
Total Credits							**18**
SIXTH SEMESTER							
1	B20BB6010	Business Policy and Strategic Management	HC	3	1	0	4
2	B20BB6020	Entrepreneurship and Innovation Management	HC	3	1	0	4
3	B20BB6080	Major Project (Based on Specialization)	HC	0	2	8	10
4	B20BB6070	SDC		0	0	0	0
OR							

1	B20BB6010	Business Policy and Strategic Management	HC	3	1	0	4
2	B20BB6020	Entrepreneurship and Innovation Management	HC	3	1	0	4
3	B20BB6030	Goods and Service Tax	HC	3	1	0	4
4	B20BB6040	Project Management	SC	2	0	1	3
5	B20BB6050	Public Relations Management	SC	2	1	0	3
6	B20BB6070	SDC		0	0	0	0
		Total Credits					**18**
		Total Credits of all Semesters					**120**

Semester-wise Summary of Credit Distribution

Semesters	**Total**
First Semester	**19**
Second Semester	**19**
Third Semester	**23**
Fourth Semester	**23**
Fifth Semester	**18**
Sixth Semester	**18**
Total Credits	**120**

Detailed Syllabus

(Effective from Academic Year 2020-21)

FIRST SEMESTER

Course Title: Communicative English – I
Course Code: B20BB1010
Course Description: This 3-credit course focuses on improving the spoken and written communication of the learners. The course develops personal, inter-personal and group skills among learners. It also addresses the functional aspects of language usage while providing specific linguistic tools through professional language learning software. The widespread reach of this course makes it highly practical and applicable.
Course Objectives: 1. To enhance functional communication skills. 2. To develop functional use of language in professional contexts. 3. To utilize oral presentations in multiple contexts. 4. To apply effective written skills in formal communication.
Course Outcomes: After the completion of the course, students will be able to: CO1: Identify pressing issues relating to society, environment and media. CO2: Develop a process-oriented approach to writing. CO3: Apply the grammatical skills developed during the course aptly. CO4: Demonstrate a good command over language usage and refined interpersonal skills.
Course Pre-requisites: The student must have knowledge of intermediate English Grammar and LSRW skills.
Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.
LTP: 2:1:0
Course type: CC
Contact Hours: 39 Hours

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Functional English** Remedial Grammar: Past Simple; Past Continuous; Irregular Verbs Writing Skills: Paragraph Writing Activities: Conversations; Leaving Phone Messages Literature: Chief Seattle – The End of Leaving and Beginning of Survival	10 Hrs.	CO1	PO5	POS1
Unit-2	**Interpersonal Skills** Remedial Grammar: Present Simple & Present Continuous; Activity & State Verbs Writing Skills: Official Letters Activities: Making Apologies; Invitations &	10 Hrs.	CO2	PO5 & PO8	POS1

	Making Arrangements Literature: Ruskin Bond – Tiger in the Tunnel				
Unit -3	**Multitasking Skills:** Remedial Grammar: Present Perfect; For, Since & How Long; -ed & -ing adjectives; Prefix & Opposites of Adjectives Writing Skills: Note Making Activities: Agreeing & Disagreeing with Opinions Literature: Jesse Owens - My Greatest Olympic Prize	10 Hrs.	CO3	PO5 & PO8	POS1
Unit-4	**Communication Skills** Remedial Grammar: Collocations; Prepositions Writing Skills: Precise Writing Activities: Offers, Suggestions & Requests Literature: Avijit Pathak – Onscreen Magic	09 Hrs.	CO4	PO5 & PO8	POS1

Reference Books:

1. Green, David. *Contemporary English Grammar Structures and Composition*. New Delhi: MacMillan Publishers, 2010.
2. Thorpe, Edgar and Showick Thorpe. *Basic Vocabulary*. Pearson Education India, 2012.
3. Leech, Geoffrey and Jan Svartvik. *A Communicative Grammar of English*. Longman, 2003.
4. Murphy, Raymond. *Murphy's English Grammar with CD*. Cambridge University Press, 2004.
5. Rizvi, M. Ashraf. *Effective Technical Communication*. New Delhi: Tata McGraw-Hill, 2005.
6. Riordan, Daniel. Technical Communication. New Delhi: Cengage Publications, 2011.
7. Sen et al. Communication and Language Skills. Cambridge University Press, 2015.

ಅಂಡಿಜ ಖಿಣಟಜ: ಕನ್ನಡ – ಐ

ಅಂಡಿಜ ಅಂಜಜ: ಃ20ಃಃ1021

ಅಂಡಿಜ ಆಙಛಿಡಿಂಠಿಣಂಠಟಿ:

ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ಮೊದಲ ಎರಡು ಸೆಮಿಸ್ಟರ್ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು; ಮೂರು ಮತ್ತು ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್ ಎರಡು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

ಅಂಡಿಜ ಟಿಂಛರಿಜಛಿಣುತಛಿ:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಸಮಗ್ರ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಪರಿಚಯಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಮೊದಲನೆಯ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ಜನಪದ, ಪ್ರಾಚೀನ, ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯಗಳು, ಹೊಸಗನ್ನಡದ ಸಣ್ಣಕಥೆಗಳು ಹಾಗು ನಾಟಕ ಸಾಹಿತ್ಯವನ್ನು ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಂಡು, ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ.
2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.
3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಹಾಗೂ ಬರಹ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ
4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ

ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

ಅಠಣಢಿಜ ಔಣಣಛಿಠಟಛ:

ಜನಪದ, ಪ್ರಾಚೀನ, ಮಧ್ಯಕಾಲೀನದ ವಿವಿಧ ಪ್ರಕಾರದ ಕಾವ್ಯಗಳು, ಹೊಸಗನ್ನಡದ ಸಣ್ಣಕಥೆಗಳು ಹಾಗು ನಾಟಕ ಸಾಹಿತ್ಯ ಕಲಿಕೆಯ ಮೂಲಕ ಕಾಲದ ಸ್ಥಿತ್ಯಂತರಗಳನ್ನು ಅದರ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

ಅಔ1: ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಯುತ್ತದೆ.

ಅಔ2: ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳು, ಸಮಸ್ಯೆಗಳನ್ನು ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.

ಅಔ3: ಉತ್ತಮ ಸಂವಹನ ಕಲೆಯನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.

ಅಔ4: ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ

ಅಠಣಢಿಜ ಕಡಿಜ–ಡಿಜಡಣ್ಣುಣಛ:

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

ಕಜಜಚಿರಠರಥಿ: ಆಡಿಜಛಿಣ ಟಜಣ್ಣುಠಜ, ಖಅಖಿ ಚಿಟಿಜ ಆರುಣಚಿಟ್ಟ ಣಠಿಠಿಠಡಿಣ, ಅಠಟಟಚಿಛಠಡಿಚಿಣುತಜ ಚಿಟಿಜ ಅಠಠಠಿಜಡಿಚಿಣುತಜ ಟಜಚಿಡಿಟುಟಿರ, ಆಜಿಜಿಜಡಿಜಟಿಣುಚಿಣಜಜ ಖಛಿಣಡಿಣಛಿಣುಠಟಿ, ಈಟುಠಿಠಿಜಜ ಅಟಛಿಡಿಠಠಟ

ಐಖಿಕ: 2:1:0

ಅಠಣಢಿಜ ಣಥಿಠಿಜ: ಅಅ

ಅಠಟಿಣಚಿಛಿಣ ಊಠಣಢಿ: 39

ಗಟುಣ	ಆಜಣಚುಟಜಜ ಖಥಿಟಟಚಿಛಣ	ಅಊ	ಅಔ	ಕಔ	ಕಖಔ
ಗಟುಣ–1	**ಜನಪದ/ಪ್ರಾಚೀನ/ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯ** 1. ಕೆರೆಗೆ ಹಾರ –ಜನಪದ ಕಾವ್ಯ 2. ಸಾಮಾನ್ಯಮೆ ಬಗೆಯೆ ಭವತ್ಕೇಶಪಾಶ ಪ್ರಪಂಚಂ? – ಪಂಪ 3. ಪೊಲ್ಲಮೆಯೆ ಲೇಸು ನಲ್ಲರ ಮೆಯ್ಯೊಳ್ – ಜನ್ನ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	ಕಔಖ1
ಗಟುಣ–2	**ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯ** 1. ನಳಕೂಬರನ ಪ್ರಸಂಗ – ನಾಗಚಂದ್ರ 2. ವಚನಗಳು – ಆಯ್ದ ವಚನಗಳು 3. ಇಳೆಯಾಂಡ ಗುಡಿಮಾರನ ರಗಳೆ – ಹರಿಹರ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	ಕಔಖ1
ಗಟುಣ–3	**ಸಣ್ಣ ಕಥೆಗಳು** 1. ಕೊನೆಯ ಗಿರಾಕಿ – ನಿರಂಜನ 2. ಪ್ರಜಾಪ್ರಭುತ್ವ ಮತ್ತು ಮೂರು ಮಂಗಗಳು – ಬೆಸಗರಹಳ್ಳಿ ರಾಮಣ್ಣ 3. ಬೆಂದಕಾಳೂರು – ವಿಜಯ್ ಹುಗಾರ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	ಕಔಖ1
ಗಟುಣ–4	**ನಾಟಕ** 1. ಜಲಗಾರ – ಕುವೆಂಪು	09 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	ಕಔಖ1

ಖಜಜಿಜಡಿಜಟಿಛಿಜ ಃಠಠಞಃ

1. ಮುಗಳಿ ರಂ.ಶ್ರೀ., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ಗೀತಾ ಬುಕ್ ಹೌಸ್, ಮೈಸೂರು. 2014
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4. ಸಂಗ್ರಹ. ನಾಗೇಗೌಡ ಎಚ್.ಎಲ್., ಕನ್ನಡ ಜನಪದ ಕಥನ ಕಾವ್ಯಗಳು, ಪ್ರಕಾಶಕರು ಕರ್ನಾಟಕ ಜಾನಪದ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು. 2007
5. ನಾರಾಯಣ ಪಿ.ವಿ, ಚಂಪೂ ಕವಿಗಳು, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
6. ಕಾಳೇಗೌಡ ನಾಗವಾರ, ತ್ರಿಪದಿ, ರಗಳೆ ಮತ್ತು ಜಾನಪದ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
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8. ಡಾ. ಚಿದಾನಂದ ಮೂರ್ತಿ, ವಚನ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2013
9. ಸಂ ಮರುಳಸಿದ್ದಪ್ಪ ಕೆ, ನಾಗರಾಜ ಕಿ.ರಂ. ವಚನ ಕಮ್ಮಟ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2016
10. ಮರುಳಸಿದ್ದಪ್ಪ ಕೆ, ಷಟ್ಪದಿ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
11. ಸಂ. ಸೇತುರಾಮ ರಾವ್ ಅ.ರಾ., ಶ್ರೀ ಲಕ್ಷ್ಮೀಶನ ಜೈಮಿನಿ ಭಾರತ(ಮೂಲ–ತಾತ್ಪರ್ಯ–ಸಚಿತ್ರ), ಪ್ರಕಾಶಕರು ಕಾಮಧೇನು ಪುಸ್ತಕ ಭವನ, ಬೆಂಗಳೂರು. 2010
12. ಸಂ. ಸೇತುರಾಮ ರಾವ್ ಅ.ರಾ., ಶಿಶುನಾಳ ಶರೀಫರ ನೂರಾರು ತತ್ವಪದಗಳು, ಪ್ರಕಾಶಕರು ಕಾಮಧೇನು ಪುಸ್ತಕ ಭವನ, ಬೆಂಗಳೂರು. 2007
13. ಸಂ. ಜಿ.ಎಸ್.ಭಟ್., ಕುಮಾರವ್ಯಾಸನ ಕರ್ಣಾಟ ಭಾರತ ಕಥಾಮಂಜರಿ ಪ್ರವೇಶ, ಪ್ರಕಾಶಕರು ಅಕ್ಷರ ಪ್ರಕಾಶನ, ಹೆಗ್ಗೋಡು, ಸಾಗರ. 2006
14. ರಂಜಾನ್ ದರ್ಗಾ, ಶರಣರ ಸಮಗ್ರ ಕ್ರಾಂತಿ, ಪ್ರಕಾಶಕರು. ಲೋಹಿಯಾ ಪ್ರಕಾಶನ, ಬಳ್ಳಾರಿ. 2015
15. ಕೀರ್ತನಾಥ ಕುರ್ತಕೋಟಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಗಾತಿ, ಪ್ರಕಾಶಕರು ಕುರ್ತಕೋಟಿ ಮೆಮೋರಿಯಲ್ ಟ್ರಸ್ಟ್, ಧಾರವಾಡ. 2009
16. ಶಾಮರಾಯ ತ.ಸು., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ತಳುಕಿನ ವೆಂಕಣ್ಣಯ್ಯ ಸ್ಮಾರಕ ಗ್ರಂಥಮಾಲೆ, ಮೈಸೂರು – 2014
17. ಶಿವರುದ್ರಪ್ಪ ಜಿ.ಎಸ್. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಮೀಕ್ಷೆ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2013
18. ಸಂ.ಜಿ.ಎಸ್.ಅಮೂರ, ಕನ್ನಡ ಸಣ್ಣ ಕಥೆಗಳು, ನಾಷನಲ್ ಬುಕ್ ಟ್ರಸ್ಟ್, ನವದೆಹಲಿ, 2000
19. ಸಂ. ಡಾ. ಬೈರಮಂಗಲ ರಾಮೇಗೌಡ, ವರ್ತಮಾನದ ಕಥೆಗಳು, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು 2011
20. ಸಂ. ಡಾ. ರಾಮಲಿಂಗಪ್ಪ ಟಿ. ಬೇಗೂರು, ವರ್ತಮಾನದ ಕಥೆಗಳು, ಕಣ್ವ ಪ್ರಕಾಶನ, ಬೆಂಗಳೂರು, 2013

Course Title: Hindi

Course Code: B20BB1022

Course Description:

यह पाठ्यक्रम नौसिखिया अपनी भाषा की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक प्रक्रियाओं द्वारा समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है |

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

CO1: सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |

CO2: साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |

CO3: समाज में अंतर्निहित पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |

CO4: साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Course Pre-requisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है |

Pedagogy: ICT and Digital support, Collaborative and Cooperative learning, Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**इकाई - 1** 1 कहानी – तावान – प्रेमचंद 2 कहानी – उसकी रोटी – मोहन राकेश 3 व्यंग्य रचना – वैष्णव की फिसलन – हरीशंकर परसाई	10Hrs.	CO1& CO2	PO5& PO8	POS1
Unit-2	**इकाई - 2** 1 कहानी – वापसी - उषा प्रियंवदा	10Hrs.	CO1& CO2	PO5& PO8	POS1

	2 कहानी – तीसरी बेटी के नाम - सुधा अरोड़ा 3 निबंध – अच्छी हिन्दी – रवीन्द्रनाथ त्यागी				
Unit-3	**इकाई - 3** 4 कहानी – जल्लाद – पांडेय बेचन शर्मा 'उग्र' 5 रेखाचित्र – बुधिया कब आएगा – ज्ञानचंद मर्मज्ञ 6 एकांकी – अंधेर नगरी – भारतेन्दु हरिश्चंद्र	10Hrs.	CO3& CO4	PO5& PO8	POS1
Unit-4	**इकाई - 4** अनुवाद अनुच्छेद (अंग्रेजी से हिन्दी में) संक्षेपण निबंध लेखन **सूचना : प्रत्येक इकाई 25 अंक केलिए निर्धारित है**	09Hrs.	CO3& CO4	PO5& PO8	POS1

Reference Books:

1. हिन्दी पाठ्य पुस्तक – रेवा विश्वविद्यालय |
2. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
3. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
4. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
5. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
6. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
7. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
8. कार्यालय अनुवाद निदेशिका
9. संक्षेपण और पल्लवन - के.सी.भाटिया&तुमन सिंग
10. हिन्दी निबंध लेखन – प्रो. विराज
    निबंध माला – योगेशचंद जैन

Course Title: Additional English – I

Course Code: B20BB1023

Course Description: This is a 3-credit course designed to help the learner gain competency in language through the introduction of various genres of literature. The course aims to inculcate a critical view among learners while sensitizing them to the contemporary issues around. It facilitates creative learning and helps to appreciate, assimilate and research on the various dimensions of society, culture and life.

Course Objectives:

1. To develop linguistic prowess of the students.
2. To appraise different genres of literature.
3. To illustrate the fundamentals of creative language.
4. To enhance consistent reading habits.

Course Outcomes:

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

CO1: Demonstrate a thorough understanding of sensitive and critical social issues.
CO2: Develop reading skills and a wide range of vocabulary.
CO3: Critically analyze a piece of prose or poetry.
CO4: Explain their opinion in a coherent and communicable manner.

Course Pre-requisites: The student must possess fundamentals of language skills and be aware of social issues.

Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

LTP: 2:1:0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Values & Ethics** Literature: Rabindranath Tagore - Where the Mind is Without Fear William Wordsworth – Three Years She Grew in Sun and Shower Saki – The Lumber-room William Shakespeare – Extract from Julius Caesar (Mark Antony's Speech) Language: Vocabulary Building	10Hrs.	CO1	PO5	POS1
Unit-2	**Natural & Supernatural** Literature: John Keats – La Belle Dame Sans Merci Charles Dickens – The Signal Man Hans Christian Anderson - The Fir Tree William Shakespeare – An Excerpt from The Tempest Language: Collective Nouns	10Hrs.	CO2	PO8	POS1
Unit-3	**Travel & Adventure** Literature: R.L. Stevenson – Travel Elizabeth Bishop - The Question of Travel	10Hrs.	CO3	PO8	POS1

	H.G. Wells – The Magic Shop Jonathan Swift – Excerpt from Gulliver's Travels Book – I Writing Skills: Travelogue				
Unit-4	**Success Stories** Literature: Emily Dickinson – Success is Counted Sweetest Rupert Brooke – Success Dr. Martin Luther King - I Have a Dream Helen Keller – Excerpt from The Story of My Life Writing Skills: Brochure &Leaflet	09Hrs.	CO4	PO5&PO8	POS1

Reference Books:

1. Tagore, Rabindranath. Gitanjali. Rupa Publications, 2002.
2. Wordsworth, William. The Complete Works of William Wordsworth. Andesite Press, 2017.
3. Munro, Hector Hugh. The Complete Works of Saki. Rupa Publications, 2000.
4. Shakespeare, William. The Complete Works of William Shakespeare. Sagwan Press, 2015.
5. Chindhade, Shirish. Five Indian English Poets: Nissim Ezekiel, A.K. Ramanujan, ArunKolatkar, DilipChitre, R. Parthasarathy. Atlantic Publications, 2011.
6. Dickens, Charles. The Signalman and Other Horrors: The Best Victorian Ghost Stories of Charles Dickens: Volume 2. Createspace Independent Publications, 2015.
7. Anderson, Hans Christian. The Fir Tree. Dreamland Publications, 2011.
8. Colvin, Sidney. The Works of R. L. Stevenson. (Edinburgh Edition). British Library, Historical Prints Edition, 2011.
9. Bishop, Elizabeth. Poems. Farrar, Straus and Giroux, 2011.
10. Swift, Jonathan. Gulliver's Travels. Penguin, 2003.
11. Dickinson, Emily. The Complete Poems of Emily Dickinson. Createspace Independent Publications, 2016.
12. Brooke, Rupert. The Complete Poems of Rupert Brooke. Andesite Press, 2017.
13. King, Martin Luther Jr. &James M. Washington. I Have a Dream: Writings and Speeches That Changed the World. Harper Collins, 1992.
14. Keller, Helen. The Story of My Life. Fingerprint Publishing, 2016.
15. Green, David. Contemporary English Grammar Structures and Composition. New Delhi: MacMillan Publishers, 2010.
16. Thorpe, Edgar and Showick Thorpe. Basic Vocabulary. Pearson Education India, 2012.
17. Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Longman, 2003.
18. Murphy, Raymond. Murphy's English Grammar with CD. Cambridge University Press, 2004.

Course Title: Fundamentals of Accounting
Course Code: B20BB1030

Course Description: The course introduces the basic framework of accounting to all students majoring in Accountancy. It Exposes accounting students to underlying accounting concepts and constraints, and help them in preparation of financial records, statements and analysis of the major financial statements.

Course Objectives:

1. This course will enable the students to combine practice and theoretical knowledge of financial accounting.
2. The course will provide decision making skills to the students in the financial analysis context.
3. The course will have the ability to identify and analyze complex financial accounting problems and opportunities in real life situations.

Course Outcomes:

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

CO1: Acquire conceptual knowledge of basics accounting and Identify events that need to be recorded in the accounting records.

CO2: Identify and analyze the reasons for the difference between cash book and pass book balances.

CO3: Equip with the knowledge of accounting process and preparation of final accounts of sole trader.

CO4: Develop the ability to use accounting information to solve a variety of business problems.

Course Pre-requisites: Basic of Accounts

Pedagogy: Direct Method and ICT

LTP: 3:0:1

Course type: HC

Contact Hours:52 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit -1	Introduction to Accounting & Accounting Process Introduction – Meaning and Definition-Objectives of Accounting – Functions of Accounting – Users of Accounting information- Limitations of Accounting – Accounting Principles –Accounting Concepts and Conventions. Meaning – Process of Accounting – Kinds of Accounts – Rules – Transaction Analysis – Journal – Ledger – Balancing of Accounts – Trail Balance Problems	12 hrs.	CO1	PO1 & PO8	POS2 & POS3
Unit-2	**Subsidiary Books** Meaning – Significance – Types of Subsidiary Books – Purchases Book – Sales Book – Purchase Returns Book – Sales Return Book – Bills Receivable Book – Bills Payable Book – Cash Book (Simple Cash Book, Double Column Cash Book, Three Column Cash Book and Petty Cash Book) and Journal proper.	12hrs.	CO2	PO1 & PO6	POS2 & POS3
Unit-3	**Final Accounts of Sole Proprietorship**	12 hrs.	CO3	PO1	POS2

	Preparation of final accounts of sole proprietor (Trading account– Profit and Loss account -Balance sheet) with adjustments (Theory and Vertical format Problems)-			& PO8	& POS3
Unit-4	**Single Entry System** Meaning – Features – Types – Merits – Demerits – Differences between single entry and double entry systems – Preparation of Opening Statement of Affairs, Closing Statement of Affairs, Computation of Profit/Loss and Revised Statement of Affairs. Conversion of single entry to double entry system.	16 hrs.	CO4	PO1 & PO8	POS2 & POS3

Reference Books:

1. T.S Grewal S.C Gupta – Introduction to Accountancy-4th edition2016- S. chand publication
2. AlvinL, Lesser, PA and Gary S, Lesser-Basic Accounting 2nd edition 2013-GSL Galactic publishing
3. S. P Jain and K. L. Narang; Financial Accounting, Kalyani Publishers.
4. Dr. Alice Mani: Fundamentals of Accounting, SBH.
5. Dr. Venkataraman R. & others, Fundamentals of Accounting, VBH

Course Title: Economics for Business

Course Code: B20BB1040

Course Description: "This course provides an introduction to the basic concepts in economics, with a focus on micro and macroeconomic environment theory. Using a small number of fundamental economic concepts, this course provides a foundation for informed decision making regarding current economic debates"

Course Objectives:

1. To familiarize the students with the concepts related to Business Economics.
2. To assist the students to develop a sound understanding on the Behavior of consumer and the market structure.
3. To Make the students understand the different kinds of competitions.

Course Outcomes:

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

CO1: To understand the Micro and Macro nature of Economics Environment
CO2: To gain knowledge about Theory of Elasticity
CO3: To understand the consumer behavioral approaches.
CO4: Analyze the features of the perfect competition.

Course Pre-requisites: Basics of Economics

Pedagogy: Lectures, Interactive sessions and class exercises using ICT models.

LTP: 2:1:0

Course type: SC

Contact Hours:39Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO

Unit-1	**Introduction to economics:** Nature and Scope of Economics: Micro and Macro Economics – Types of Economies-Basic problems of an Indian economy. –Business Economics-Scope-Goals of Business Economics-Difference between economics and business economics	08 Hrs.	CO1	PO4	POS1
Unit-2	**Theories of demand and analysis:** Demand –Demand determinants –Law of demand-Elasticity of demand-Price Elasticity-Types-Determining Factors-Change in demand and elasticity of demand-Business applications of price elasticity-Concepts of income and cross elasticity of demand-Price elasticity of demand measurement by total outlay method.	12 Hrs.	CO2	PO2 & PO4	POS1
Unit-3	**Consumer behaviour:** Consumer Sovereignty-Limitations-Approaches to the study of consumer behavior- Cordial approach-The law of Equi–Marginal utility- Ordinal approach – Indifference curve analysis – Properties – Consumer surplus – Meaning- Analysis – Limitations.	09 Hrs.	CO3	**PO2**	POS1
Unit-4	**Market structure:** Perfect Competition: Features- Equilibrium of the firm and industry in the short run and long run (b) Imperfect Competition: Difference between perfect competitions and imperfect competition; Monopolistic Competition: Assumption; Short-run Equilibrium. (c) Monopoly: Features short run and long-run equilibrium of monopoly firm (d) Oligopoly: Features short run and long-run equilibrium of monopoly firm.	10 Hrs.	CO4	PO2 & PO4	POS1

Reference Books:

1. Pindyck, R.S., D.L. Rubinfeld and P. L. Mehta; *Microeconomics,* Pearson Education.
2. N. Gregory Mankiw, *Priciples of Micro Economics*, Cengage Learning (Latest Edition)
3. Gould, J.P. and E.P. Lazear; Microeconomic Theory, All India Traveler Bookseller, New Delhi.
4. Lipsey, R.G and K.A. chrystal; *Economics*, Oxford University Press.

Course Title: Introduction To Management

Course Code: B20BB1050

Course Description: This course is designed to enable learners in surveying the field of management. This course provides learners with a systematic approach to acquire a solid foundation in the principles of management and also enables learners in analyzing and solving management problems that managers face in industry in different phases of planning, organizing, leading, and controlling.

Course Objective

1. To introduce students to management concepts, and to provide tools in analyzing and solving management problems that managers face in industry in different phases of planning, organizing, leading, and controlling.
2. To compare major schools of thought in the evolution of management theory.
3. To Elucidate different approaches and their applicability in present context.

Course Outcomes:

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

CO1: Knowledgeably discuss the concepts of management and its functions and explain and apply the various management principles.

CO2: Distinguish between the different types of plans and explain the planning process and Understand and apply the process of decision making in all activities.

CO3: Illustrate and understanding of the principles of organizing in various activities and apply the various types of staffing practices in real world scenarios.

CO4: Identify characteristics of effective leaders, design organizational practices that motivate employees using major theories of motivation and develop an organization's control system

Course Pre-requisites: Business Studies

Pedagogy: ICT, Interactive Learning / Flipped Classroom, Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Management** Meaning, Nature and Concept of Management - Importance of Management, Role of Managers – Management as a profession – Management & Administration - Evolution of Management thought - Trends and Challenges of Management in Global Scenario – Functions of Management.	10 Hrs.	CO1	PO 3 & PO 4	POS1
Unit-2	**Planning** Nature – Types – Importance - Steps in Planning Process - Long range and Short-range Planning – Objectives – MBO – Premising - Decision Making – Types of Decisions - Techniques in Decision Making - Strategies & Policies – Different Approaches to Plan Strategies - Making Planning effective - Open System Approach to Planning.	10 Hrs.	CO2	PO 3 & PO 4	POS1
Unit-3	**Organising & Staffing** Span of Management - Graicuna's Theory of Superior-subordinate Relationship - Factors influencing Span of Management - Wide versus Narrow Spans - Decentralization of Authority - Principles of Delegation - Types & Classification of Organizational	10 Hrs.	CO3	PO 3 & PO 4	POS1

	structures. Staffing – Concept – Recruitment - Selection - Training& Development - Performance Appraisal				
Unit-4	**Directing & Controlling** **Directing**: Nature - Concept of Leadership - Leadership Styles - Theories of Leadership – Charismatic Leadership Theory - Concept of Motivation - Relevance of Communication. **Controlling:** Concept - Importance of Control - Control Process - Types of Control Mechanism – Managing the Control Process - Management by Exceptions.	9 Hrs.	CO4	PO 3 & PO 4	POS1

Reference Books:

1. Jones, G. R., & George, J. M. (2015). Essentials of Contemporary Management (6th international edition). Boston, MA: McGraw-Hill/Irwin.
2. Robbins, Coulter, DeCenzo (2012). Fundamentals of Management. 10th edition, Pearson.
3. Magretta, J. and Stone, N. (2012): What Management Is - How it Works and Why It's Everyone's Business: The Free Press
4. Drucker, P. F. (1974). Management: Tasks, responsibilities, practices. New York: Harper & Row.
5. Koontz, H., O'Donnell, C., &Weihrich, H. (1982). Essentials of management. New York: McGraw-Hill

Course Title: Business Organization and Environment

Course Code: B20BB1060

Course Description: This course is designed to enable learners in surveying the field of management. This course provides learners with a systematic approach to acquire a solid foundation in the Business organization and its environment and also enables learners in analyzing and solving management problems that managers face in industry in different phases of planning, organizing, leading, and controlling.

Course Objective

1. To provide knowledge of the environment in which businesses operate, the economic operational and financial framework.
2. Outline how an entity operates in a business environment.
3. To elucidate different approaches and their applicability in present context.

Course Outcomes:

After the completion of the course, students will be able to:
CO1: Understand the concepts and establishment of business
CO2: Describe on Forms of business organization
CO3: Discuss on Business and Its Environment
CO4: Identify the characteristics Global Environment

Course Pre-requisites: Business Studies

Pedagogy: ICT, Interactive Learning / Flipped Classroom

LTP: 2:1:0

Course type: SC

Contact Hours:39					
Units	**Detailed Syllabus**	**CH**	**CO**	**PO**	**PSO**
Unit-1	**Business** – Concept, nature and scope, business as a system, business objectives, business and environment interface, distinction between business, commerce and trade. **Business Unit**, Establishing a new business unit. Meaning of Promotion. Features for business, Plant location, Plant Layout & size of business unit,	10 Hrs.	CO1	PO 7	POS1
Unit-2	**Forms of business organization** – Sole proprietorship, partnership, joint stock company, types of company cooperative societies; multinational corporations. **Business Combination** Meaning Causes, Objectives, Types and Forms Mergers, Takeovers and Acquisitions.	10 Hrs.	CO2	PO 1 & PO 2	POS1
Unit-3	**Business and Its Environment:** Meaning-Scope and Characteristics of Business Environment-Theories of International Business.	10 Hrs.	CO3	PO 4	POS1
Unit-4	**Global Environment:** Meaning – Definition and feature of globalization–Merits and demerits of globalization-Barriers of globalization–Challenges of international business strategies for going global in India – WTO – Objectives- Functions- organization structure- Trading blocs - SAARC.	9 Hrs.	CO4	PO 4	POS1

References

1. Dr. Aswathappa: Essentials of Business Environment, HPH.
2. Francis Cherrunilam : Business Environment, HPH.
3. Muniraju S.K. Podder – Business Organisation & Environment, VBH
4. VivekMittall, – Business Environment, Excel Books, New Delhi.
5. Raj Agarwal – Business Environment, Excel Books, New Delhi.
6. K. Venkataramana, Business Environment, SHB Publishers.
7. Dr. Alice Mani: Business Organization & Environment, SBH.

Course Title: Indian Constitution and Human Rights
Course Code: B20BB1070

Course Description: This course provides the student with in-depth information about the Indian constitution, directive principles and Human rights, that every citizen of the country should know and follow. It provides a good understanding about constitutional, statutory and institutional aspects of human rights protection in India. It covers constitutional provisions dealing with human rights and special legislations regarding protection of human rights and minority rights.

Course Objectives:

1. To acquire the knowledge of evolution of the Indian constitution and to comprehend the union and state executive, legislature and judiciary function.
2. To discuss the concepts and development human rights in India and to describe the protection of Human Right Act and evolution of human right in India.

Course Outcomes:

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

CO1: Acquire the knowledge of preamble, fundamental rights and duties.
CO2: Identify and recognize how state legislature and judiciary function.
CO3: Know aware the knowledge about of Human Rights Act.
CO4: Understand the evolution, protection and judiciary activities of Human Rights in India.

Course Pre-requisites: Basic Knowledge of Constitution

Pedagogy: ICT and Direct Method

LTP: 0:0:0

Course type: FC

Contact Hours: 30

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Indian Constitutional Philosophy:** a) Features of the Constitution and Preamble b) Fundamental Rights and Fundamental Duties c) Directive Principles of State Policy	7Hrs.	CO1	PO7	POS1
Unit-2	**Union and State Executive, Legislature and Judiciary:** Union Parliament and State Legislature: Powers and Functions President, Prime Minister and Council of Ministers State Governor, Chief Minister and Council of Ministers The Supreme Court and High Court: Powers and Functions	8 Hrs.	CO2	PO6	POS1
Unit-3	**Concept and Development of Human Rights:** a) Meaning Scope and Development of Human Rights b) United Nations and Human Rights-UNHCR c) UDHR 1948, ICCR 1996 and ICESCR	8 Hrs.	CO3	PO7	POS1

	1966				
Unit-4	**Human Rights in India:** a) Protection of Human Rights Act, 1993(NHRC & SHRC) b) First, Second and Third Generations-Human Rights c) Judicial Activities and Human Rights	7 Hrs.	CO4	PO7	POS1

Reference Books:

1. M.P. Singh (ed.), V.N. Shukla, Constitutional Law of India (2000), Oxford.
2. S.C Kashyap, Human Rights and Parliament (1978) Metropolitan, New Delhi.
3. Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd. New Delhi.
4. Subash Kashyap, Indian Constitution, National Book Trust.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B20BB1080	**Skill Development Course**	**RULO**	**0**	**0**	**0**	**0**	**4**

SECOND SEMESTER

Course Title: Business Communication

Course Code: B20BB2010

Course Description: This course is designed to give students a comprehensive view of communication, its scope and importance in business, and the role of communication in establishing a favorable outside the firm environment, as well as an effective internal communications program. The various types of business communication media are covered. This course also develops an awareness of the importance of succinct written expression to modern business communication.

Course Objectives:

1. Understand and demonstrate the use of basic and advanced proper writing techniques that today's technology demands, including anticipating audience reaction.
2. Prepare informal and formal reports
3. Develop interpersonal skills that contribute to effective and satisfying personal, social and professional relationships, and Utilize electronic presentation software.
4. Write effective and concise letters and memos.

Course Outcomes:

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

CO1: Apply business communication theory to solve workplace communication issues.

CO2: Demonstrate the communication skills required in the workplace.

CO3: Understand complex ideas in written and spoken formats.

CO4: Express complex ideas accurately in written and spoken formats.

Course Pre-requisites: The student must possess functional knowledge of LSRW skills.

Pedagogy: Direct method, ICT, Collaborative learning, Flipped Classroom.

LTP: 2:1:0

Course type: CC

Contact Hours: 39 Hours

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	Nature of Communication Process of Communication, Types of Communication (verbal & Non-Verbal), Importance of Communication, Differences between Technical and General Communication. Different forms of Communication. Barriers to Communication Causes, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers. Measures to Overcome the Barriers to Communication.	**9** Hrs.	CO1	PO8	POS1
Unit-2	**Communication in Organizations**: Internal Communication; Stake Holders in Internal Communication; Channels of Internal Communication; External Communication; Stake Holders in External Communication; Channels of External Communication. Vocabulary Words often confused, Words often misspelt, Common errors in English. Oral Presentation Importance,	10 Hrs.	CO2	PO8	POS1

	Characteristics, Presentation Plan, Power point presentation, Visual aids.				
Unit -3	**Business Correspondence**: Letter Writing, presentation, inviting quotations, sending quotations, placing orders, inviting tenders, Sales letters, claim & adjustment letters and social correspondence, Memorandum, Inter -office Memo, Notices, Agenda, Minutes, Job application letter, preparing the Resume. Writing E-mail: Principles of E-mail; E-mail Etiquette; Overcoming Problems in E-mail Communication.	10 Hrs.	CO3	PO8	POS1
Unit-4	**Report Writing:** Features of Writing a Good Report; Purpose of Report Writing; Difference between Business Report and Engineering Report-Characteristics of writing a good report-Importance of communication in report writing; Guidelines for Report Writing; Steps in Report Writing; Structure of Report; Types of Reports and Different Formats.	10 Hrs.	CO4	PO5 & PO8	- POS1

Reference Books:

1. Lesikar, R.V. & Flatley, M.E.; Basic Business Communication Skills for Empowering the Internet Generation, Tata McGraw Hill Publishing Company Ltd. New Delhi.

2. Bovee, and Thill, Business Communication Today, Pearson Education

3. Shirley Taylor, Communication for Business, Pearson Education

4. Locker and Kaczmarek, Business Communication: Building Critical Skills, TMH

ಅಠಣಢಿಜ ಆಭಛಿಡಿಠಿಣುಠಟಿ:

ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ಮೊದಲ ಎರಡು ಸೆಮಿಸ್ಟರ್ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು; ಮೂರು ಮತ್ತು ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್ ಎರಡು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

ಅಠಣಢಿಜ ಔಛರಿಜಛಿಣುತಭಿ:

ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಸಮಗ್ರ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಪರಿಚಯಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಎರಡನೆಯ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯಗಳು, ಲೇಖನಗಳು ಹಾಗು ಸಂಕೀರ್ಣ ಸಾಹಿತ್ಯವನ್ನು ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಂಡು, ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ.
2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.
3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಹಾಗೂ ಬರಹ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ
4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

ಅಠಣಢಿಜ ಔಣಣಛಿಠಟಭಿ:

ಮಧ್ಯಕಾಲೀನದ ವಿವಿಧ ಪ್ರಕಾರದ ಕಾವ್ಯಗಳು, ಲೇಖನಗಳು ಮತ್ತು ಸಂಕೀರ್ಣ ಬರಹ ಸಾಹಿತ್ಯ ಕಲಿಕೆಯ ಮೂಲಕ ಕಾಲದ ಸ್ಥಿತ್ಯಂತರಗಳನ್ನು ಅದರ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

ಅಔ1:ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಯುತ್ತದೆ.

ಅಔ2: ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳು, ಸಮಸ್ಯೆಗಳನ್ನು ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.

ಅಔ3:ಉತ್ತಮ ಸಂವಹನ ಕಲೆಯನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.

ಅಔ4:ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.

ಅಠಣಢಿಜ ಕಡಿಜ–ಡಿಜಡಣ್ಣುಣಭಿ:

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

ಕಜಜಚಿರಠರಥಿ: ಆುಡಿಜಛಿಣ ಟಜಣ್ಣುಠಜ, ಖಅಖಿ ಚಿಟಿಜ ಆುರುಣಚಿಟ ಣಠಿಠಿಠಡಿಣ (ಐಟಿಞ ಚಿಣಣಚಿಛ್ಛಿಜಜ), ಅಠಟಟಚಿಛಠಡಿಚಿಣುತಜ ಚಿಟಿಜ ಅಠಠಠಿಜಡಿಚಿಣುತಜ ಟಜಚಿಡಿಟುಟಿರ, ಆುಜಿಜಿಜಡಿಜಟಿಣುಚಿಣಜಜ ಖಟಿಣಡಿಣಛಿಣುಠಟಿ, ಈಟುಠಿಠಿಜಜ ಅಟಛಿಡಿಠಠಟ

ಐಖಿಕ: 2:1:0

ಅಠಣಢಿಜ ಣಥಿಠಿಜ: ಅಅ

ಅಠಟಿಣಚಿಛಿಣ ಊಠಣಢಿ: 39 ಎಠಣಢಿ

ಗಟುಣ	ಆಜಣಚುಟಜಜ ಖಥಿಟಟಚಿಛಣ	ಅಊ	ಅಔ	ಕಔ	ಕಖಔ
ಗಟುಣ–1	**ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯ** 1. ಗಾನರಾಣಿಯರ ಸಂವಾದ – ರಾಘವಾಂಕ 2. ಸಿಡಲ ಪೊಟ್ಟಣ ಕಟ್ಟಿ ಸೇಖವ ಕೊಡುವರೆ – ಕುಮಾರವ್ಯಾಸ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	– ಕಔಖ1

	3. ಸರ್ವಜ್ಞನ ವಚನಗಳು – ಸರ್ವಜ್ಞ				
ಗಟಿಣ–2	**ಮಧ್ಯಕಾಲೀನ ಕಾವ್ಯ** 1. ಗಿಳಿಯು ಪಂಜರದೊಳಿಲ್ಲ – ಪುರಂದರದಾಸ **2.** ಎಲ್ಲಾರು ಮಾಡುವುದು – ಕನಕದಾಸ **3.** ಎಲ್ಲರಂತವನಲ್ಲ ನನಗಂಡ – ಶಿಶುನಾಳ ಶರೀಫ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	– ಕಔಖ1
ಗಟಿಣ–3	**ಲೇಖನಗಳು** 1. ಪೈಪೋಟಿಗೆ ಸಜ್ಜಾಗುತ್ತಿರುವ ದೇಶ – ಎ.ಪಿ.ಜೆ. ಅಬ್ದುಲ್ ಕಲಾಂ 2. ಬಾಪು ಚಿಂತನೆ – ಬಿ. ಎ. ಶ್ರೀಧರ 3. ಭಾರತ ಸಂವಿಧಾನಕ್ಕೆ 'ಭೂತ' ಚೇಷ್ಟೆ – ದೇವನೂರು ಮಹದೇವ	10 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	– ಕಔಖ1
ಗಟಿಣ–4	**ಸಂಕೀರ್ಣ ಬರಹ** 1. ಸಹಜ ಕೃಷಿ – ಪೂರ್ಣ ಚಂದ್ರ ತೇಜಸ್ವಿ	9 ಊಢಿ.	ಅಔ1, ಅಔ2, ಅಔ3, ಅಔ4	ಕಔ5, ಕಔ8	– ಕಔಖ1

ಖಜಜಿಜಡಿಜಟಿಛಿಜ ಃಠಠಘಃ:

1. ಮುಗಳಿ ರಂ. ಶ್ರೀ., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ಗೀತಾ ಬುಕ್ ಹೌಸ್, ಮೈಸೂರು. 2014
2. ಸಂಗ್ರಹ. ನಾಗೇಗೌಡ ಎಚ್.ಎಲ್., ಚಾರಿತ್ರಿಕ ಜನಪದ ಕಥನ ಕಾವ್ಯಗಳು, ಪ್ರಕಾಶಕರು ಕರ್ನಾಟಕ ಜಾನಪದ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು. 2008
3. ಸೀಮಾತೀತ ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ ಸಂಪುಟ 1,2,3,4,5 ಮತ್ತು 6, ಕುವೆಂಪು ಕನ್ನಡ ಅಧ್ಯಯನ ಸಂಸ್ಥೆ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು. 2014
4. ಸಂಗ್ರಹ. ನಾಗೇಗೌಡ ಎಚ್.ಎಲ್., ಕನ್ನಡ ಜನಪದ ಕಥನ ಕಾವ್ಯಗಳು, ಪ್ರಕಾಶಕರು ಕರ್ನಾಟಕ ಜಾನಪದ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು. 2007
5. ನಾರಾಯಣ ಪಿ. ವಿ, ಚಂಪೂ ಕವಿಗಳು, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
6. ಕಾಳೇಗೌಡ ನಾಗವಾರ, ತ್ರಿಪದಿ, ರಗಳೆ ಮತ್ತು ಜಾನಪದ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
7. ಸಂ. ಬೆನಗಲ್ ರಾಮ ರಾವ್ ಮತ್ತು ಪಾನ್ಯಂ ಸುಂದರ ಶಾಸ್ತ್ರೀ, ಪುರಾಣ ನಾಮ ಚೂಡಾಮಣಿ, ಪ್ರಕಾಶಕರು ಪ್ರಸಾರಾಂಗ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ. 2010
8. ಡಾ. ಚಿದಾನಂದ ಮೂರ್ತಿ, ವಚನ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2013
9. ಸಂ ಮರುಳಸಿದ್ದಪ್ಪ ಕೆ, ನಾಗರಾಜ ಕಿ.ರಂ. ವಚನ ಕಮ್ಮಟ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2016
10. ಮರುಳಸಿದ್ದಪ್ಪ ಕೆ, ಷಟ್ಪದಿ ಸಾಹಿತ್ಯ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2010
11. ಸಂ. ಸೇತುರಾಮ ರಾವ್ ಅ.ರಾ., ಶ್ರೀ ಲಕ್ಷ್ಮೀಶನ ಜೈಮಿನಿ ಭಾರತ(ಮೂಲ–ತಾತ್ಪರ್ಯ–ಸಚಿತ್ರ), ಪ್ರಕಾಶಕರು ಕಾಮಧೇನು ಪುಸ್ತಕ ಭವನ, ಬೆಂಗಳೂರು. 2010
12. ಸಂ. ಸೇತುರಾಮ ರಾವ್ ಅ.ರಾ., ಶಿಶುನಾಳ ಶರೀಫರ ನೂರಾರು ತತ್ವಪದಗಳು, ಪ್ರಕಾಶಕರು ಕಾಮಧೇನು ಪುಸ್ತಕ ಭವನ, ಬೆಂಗಳೂರು. 2007
13. ಸಂ. ಜಿ. ಎಸ್.ಭಟ್., ಕುಮಾರವ್ಯಾಸನ ಕರ್ಣಾಟ ಭಾರತ ಕಥಾಮಂಜರಿ ಪ್ರವೇಶ, ಪ್ರಕಾಶಕರು ಅಕ್ಷರ ಪ್ರಕಾಶನ, ಹೆಗ್ಗೋಡು, ಸಾಗರ. 2006
14. ರಂಜಾನ್ ದರ್ಗಾ, ಶರಣರ ಸಮಗ್ರ ಕ್ರಾಂತಿ, ಪ್ರಕಾಶಕರು. ಲೋಹಿಯಾ ಪ್ರಕಾಶನ, ಬಳ್ಳಾರಿ. 2015
15. ಕೀರ್ತನಾಥ ಕುರ್ತಕೋಟಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಗಾತಿ, ಪ್ರಕಾಶಕರು ಕುರ್ತಕೋಟಿ ಮೆಮೋರಿಯಲ್ ಟ್ರಸ್ಟ್, ಧಾರವಾಡ. 2009
16. ಶಾಮರಾಯ ತ.ಸು., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ತಳುಕಿನ ವೆಂಕಣ್ಣಯ್ಯ ಸ್ಮಾರಕ ಗ್ರಂಥಮಾಲೆ, ಮೈಸೂರು –2014
17. ಶಿವರುದ್ರಪ್ಪ ಜಿ.ಎಸ್. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಮೀಕ್ಷೆ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2013

Course Title: Hindi
Course Code: B20BB2022

Course Description:

यह पाठ्यक्रम नौसिखिया अपनी भाषा की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक प्रक्रियाओं द्वारा समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है |

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

CO1: सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |

CO2: साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |

CO3: समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |

CO4: साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Course Pre-requisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है |

Pedagogy: ICT and Digital support, Collaborative and Cooperative learning, Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**इकाई - 1** 1 कबीरदास के दोहे – कबीरदास 2 कविता – अर्जुन की प्रतिज्ञा - मैथिलीशरण गुप्त 3 कविता – वीरों का कैसा हो बसंत – सुभद्रकुमारी चौहान	10Hrs.	CO1	PO5& PO8	POS1
Unit-2	**इकाई – 2** 1 तुलसीदास के पद –तुलसीदास	10Hrs.	CO2	PO5& PO8	POS1

	2 कविता – संध्या सुंदरी – सूर्यकांत त्रिपाठी 'निराला' 3 कविता – करमवीर – अयोध्या सिंह उपाध्याय ' हरिऔंध'					
Unit-3	**इकाई – 3** 4 मीराबाई के पद – मीराबाई 5 कविता – मधुशाला – हरिवंशराय बच्चन 6 कविता – हम झुक नहीं सकते – अटलबिहारी बाजपाई	10Hrs.	CO3	PO5& PO8		
Unit-4	**इकाई - 4** अनुवाद अनुच्छेद (हिन्दी से अंग्रेजी) सृजनात्मक व्यक्तित्व अ कबीर, महादेवी वर्मा, प्रेमचंद आ महात्मा गांधी, डॉ बाबासाहेब आंबेडकर, अब्दुल कलाम **सूचना : प्रत्येक इकाई 25 अंक केलिए निर्धारित है**	09Hrs.	CO4	PO5& PO8	POS1	

Reference Books:

1. हिन्दी पाठ्य पुस्तक – रेवा विश्वविद्यालय |
2. सुबोध व्यवहारिक हिन्दी – डॉ. कुलदीप गुप्त
3. अभिनव व्यवहारिक हिन्दी – डॉ.परमानन्द गुप्त
4. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
5. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
6. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
7. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
8. कार्यालय अनुवाद निदेशिका
9. संक्षेपण और पल्लवन - के.सी.भाटिया&तुमन सिंग

Course Title: Additional English – II

Course Code: B20BB2023

Course Description: This is a 3-credit course designed to help the learner gain competency in language through the introduction of various genres of literature. The course aims to inculcate a critical view among learners while sensitizing them to the contemporary issues around. It facilitates creative learning and helps to appreciate, assimilate and research on the various dimensions of society, culture and life.

Course Objectives:

1. To assess ecological and environmental concerns through literature.
2. To identify the unequal structures of power in society.
3. To compare the position of men and women in society.
4. To interpret the representation of society in popular culture.

Course Outcomes:

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

CO1: Demonstrate a thorough understanding of sensitive and critical ecological and environmental issues.
CO2: Analyze the rigid structure of center and margin in our society.
CO3: To criticize the subordinate position of women in society.
CO4: To justify the depiction of society in popular culture.

Prerequisites: The student must possess fair knowledge of language and literature.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

LTP: 2:1: 0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Ecology & Environment** Literature: Toru Dutt - Casuarina Tree Robert Frost – Stopping by Woods on a Snowy Evening Tomas Rivera –The Harvest C.V. Raman – Water – The Elixir of Life Language: Degrees of Comparisos	10Hrs.	CO1	PO8	POS1
Unit-2	**Voices from the Margin** Literature: Tadeusz Rozewicz – Pigtail Jyoti Lanjewar – Mother Sowvendra Shekhar Hansda – The Adivasi Will Not Dance Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl Language: Prefix and Suffix	10Hrs.	CO2	PO8	POS1
Unit 3:	**Women & Society**	10Hrs.	CO3	PO5&8	POS1

		Literature: Kamala Das – An Introduction Usha Navrathnaram – To Mother Rabindranath Tagore – The Exercise Book Jamaica Kincaid – Girl Writing Skills: Dialogue Writing					
	Unit 4:	**Popular Culture** Literature: Rudyard Kipling – The Absent-minded Beggar Sir Arthur Conan Doyle – The Hound of the Baskervilles Aldous Huxley – The Beauty Industry Writing Skills: Story Writing	09Hrs.	CO4	PO5	POS1	

Reference Books:

1. Agrawal, K.A. Toru Dutt the Pioneer Spirit of Indian English Poetry - A Critical Study. Atlantic Publications, 2009.
2. Latham, Edward Connery (ed). The Poetry of Robert Frost. Holt Paperbacks, 2002.
3. Gale, Cengage Learning. A Study Guide for Tomas Rivera's The Harvest. Gale, Study Guides, 2017.
4. Basu, Tejan Kumar. The Life and Times of C.V. Raman. PrabhatPrakashan, 2016.
5. Rozewicz, Tadeusz. New Poems. Archipelago, 2007.
6. Manohar, Murli. Critical Essays on Dalit Literature. Atlantic Publishers, 2013.
7. Hansda, SowvendraShekhar. The Adivasi Will Not Dance: Stories. Speaking Tiger Publishing Private Limited, 2017.
8. Jacobs, Harriet. Incidents in the Life of a Slave Girl. Createspace Independent Publication, 2014.
9. Das, Kamala. Selected Poems. Penguin Books India, 2014.
10. Tagore, Rabindranath. Selected Short Stories of Rabindranath Tagore. Maple Press, 2012.

Course Title: Statistics for Management
Course Code: B20BB2030

Course Description: This course is designed to provide students with an understanding of the data and its relevance in business and develop an understanding of the quantitative techniques from statistics. A particular emphasis is placed on developing the ability to interpret the numerical information that forms the basis of decision-making in business.

Course Objectives:

1. To develop the student's ability to deal with numerical and quantitative issues in business
2. To enable the use of statistical, graphical and algebraic techniques wherever relevant
3. To have a proper understanding of Statistical applications in Economics and Management.

Course Outcomes:

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

CO1: To understand the key terminologies of Statistics

CO2: To familiarize the concepts of Skewness

CO3: to gain the knowledge of correlation and regression techniques

CO4: Critically evaluate statistical Index results

Course Pre-requisites: Basic Mathematics

Pedagogy: Flipped class rooms, ICT and Direct Method

LTP: 3:0:1

Course type: HC

Contact Hours:52 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Statistics** Introduction – Meaning and Definition -Functions – Scope – Limitations, Classification and Tabulation of Data-Diagrams and graphs. Measures of central tendency- Arithmetic Mean (Simple and Weighted) – Median – Mode (including missing frequency problems) – Graphic location of Median and Mode through Ogive Curves	14 hrs.	CO1	PO2 & PO6	POS2 & POS3
Unit-2	**Measures of Dispersion and Skewness** Meaning– Calculation of Absolute and Relative measures of dispersion - Range – Quartile Deviation – Mean Deviation – Standard Deviation and Coefficient of Variation. Measures of Skewness -meaning- Absolute and Relative Measures of Skewness – Karl Pearson's Coefficient of Skewness and Bowley's Coefficient of Skewness	14hrs	CO2	PO5 & PO2	POS2 & POS3
Unit-3	**Correlation and Regression Analysis** Correlation – Meaning & Definition - Uses – Types – Probable error – Karl Pearson's & Spearman's Rank Correlation (Excluding Bi-variate and Multiple correlation). Regression – Meaning and Definition, Regression Equations - Problems	12 hrs.	CO3	PO5 & PO2	POS2 & POS3

Unit-4	**Index Numbers** Meaning & Definition – Uses – Classification – Construction of Index Numbers – Methods of constructing Index Numbers – Simple Aggregate Method – Simple Average of Price Relative Method – Weighted Index numbers – Fisher‟s Ideal Index (including Time and Factor Reversal tests) – Consumer Price Index – Problems	12 hrs.	CO4	PO5 & PO2	POS2 & POS3

Reference Books:

- David M Levine, David Stephan-Business Statistics 7th Edition 2017 - Pearson Education Publications
- J.K sharma, Business statistics -4th edition 2014- Vikas publishing House
- Richard I Levin David S Rubin- Statistics for Management – 7thedition 2017- Pearson Education publications.
- R S N Pillai Bagavathi- Statistics Theory and Practice -8th Edition 2016 – S Chand Publishing

Course Title: Corporate Accounting

Course Code: B20BB2040

Course Description: This course covers the analysis of goodwill and shares used by companies in preparing their annual reports for shareholders and other end users of financial information. It enables to students develop the basic skills in Banking Company's accounts and holding companies Statements.

Course Objectives:

1. To Value the goodwill and shares under various methods
2. To Familiarize with Corporate Accounting procedure and to understand the accounting for Banking companies.
3. The Subject differentiate profit and loss prior period to acquisition and post incorporation.

Course Outcomes:

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

CO1: To provide knowledge on valuation of Goodwill

CO2: To familiarizes the concept of valuation of shares.

CO3: To make them aware about accounts of Banking companies.

CO4: To introduce and develop knowledge of holding companies accounts.

Course Pre-requisites: Financial accounting

Pedagogy: Direct Method and ICT

LTP: 2:0:1

Course type: SC

Contact Hours: 39Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO

Unit-1	**Valuation of Goodwill** Meaning – Circumstances of Valuation of Goodwill – Factors influencing the value of Goodwill – Methods of Valuation of Goodwill - Average Profit Method – Super Profit Method – Capitalization of Super Profit Method – Annuity Method – Capitalization of Profit Method.	08 hrs.	CO1	PO1 & PO2	POS2 & POS3
Unit-2	**Valuation of Shares** Meaning – Need for Valuation – Factors Affecting Valuation – Methods of Valuation – Asset Backing or Intrinsic Value Method – Yield Method – Earning Capacity Method – Fair Value Method - Rights Issue and Valuation of Rights Issue.	09 hrs.	CO2	PO1 & PO2	POS2 & POS3
Unit-3	**Accounts of Banking Companies** Meaning –special features of bank accounting, final accounts - balance sheet and profit and loss account –problems as per new provisions.	11 hrs.	CO3	PO1 & PO2	POS2 & POS3
Unit-4	**Holding Company Accounts** Introduction – Meaning of Holding Company – Subsidiary Company – Steps – Pre-Acquisition Profits – Post Acquisition Profits – Minority Interest – Cost of Control or Capital Reserve – Unrealized Profit – Mutual Indebtedness – Preparation of Consolidated Balance Sheet (As per AS21).	11 hrs.	CO4	PO1 & PO2	POS2 & POS3

Reference Books:

- Bushankumar Goyal "coroporate Accounting" 7th Edition 2020 Taxmann publisher
- P.C Tulsian, Bharat Tulsian "Corporate Accountin' 2nd Edition 2016 -S Chand Publishing
- M Hanif, M Mukherjee 'Corporate Accounting" 3rdedition 2019Mcgraw hill publications
- Soumya Mukerjee"Corporate Accounting" 3rdediton 2019 Oxford university publication.

Course Title: Marketing Management
Course Code: B20BB2050
Course Description: The course explains the nature and purpose of marketing, followed by the fundamentals of each of the most important marketing tasks. It analyses the business need for customer orientation, the evaluation of markets and the targeting of market opportunities.
Course Objectives: 1. To enhance your knowledge about marketing theories, principles, strategies and concepts and how they are applied; 2. To provide you with opportunities to analyze marketing activities within the firm; 3. To allow you to apply marketing concepts and theories to realistic marketing situations.

Course Outcomes:
After the completion of the course, students will be able to:

CO1: Understand the concept and functions of Marketing.

CO2: Identify product segments.

CO3: Understand how organizations use the marketing mix to market to their target customers

CO4: To gain knowledge about recent Trends in Marketing.

Course Pre-requisites: Basic Knowledge about product, price selling concepts.

Pedagogy: Blended learning, Flip classes, Direct Method, online assignments

LTP: 2:1:0

Course type: SC

Contact Hours: 39 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Marketing** Meaning, Evolution of marketing concepts, functions, marketing mix: Marketing environment-Micro and Macro environmental factors, Consumer Behavior –Consumer buying process, Factors influencing consumer buying decisions. (Case Study: Nano Failure)	10 Hrs.	CO1	PO4	POS1
Unit-2	**Segmentation Targeting Positioning** Market segmentation – concept, importance and bases, Target market selection: Positioning concept, importance and bases: Product differentiations.	9 Hrs.	CO2	PO2	POS1
Unit-3	**Marketing Mix** **Product:** Meaning and importance, Product classifications, Characteristics of services, Concept of product mix, Product life-cycle, new product development. Managing Brands and branding strategies. (Managing Brands: The Case of HUL) **Pricing**: Importance of pricing, objectives of pricing Factors affecting price of product, pricing methods. Steps involved in pricing. **Promotion:** Nature and importance of promotion: Promotion tools: advertising, personal selling, public relations: sale promotion and publicity. Promotion mix: Factors affecting promotion mix decisions. **Place:** Channels of distribution Meaning and importance: Types of distribution channels: Wholesaling and retailing, Franchising: Factors affecting choice of distribution channel. (Case Study: CHANNEL STRATEGY: TITAN WATCHES)	11 Hrs.	CO3	PO2 & PO6	POS1
Unit-4	**Developments & Issues in Marketing**	9	CO4		POS1

	Rural marketing, Social marketing, Global marketing, E- marketing, Green marketing, CRM, marketing ethics.	Hrs.		PO4	

Reference Books:

1. Management: A South Asian Perspective, Pearson Publishing House, New Delhi.
2. Ramaswamy, V.S.: and Namakumari: Marketing Management – Planning implementation and control, Mc Millan India Ltd., New Delhi.
3. Armstrong & Kotler, Marketing: An Introduction, Pearson Publishing House, New Delhi
4. Palmer, Adrian, Introduction to Marketing, Oxford University Press, UK.

Course Title: Organizational Behaviour

Course Code: B20BB2060

Course Description:

This course covers the explanations about the human behavior in the organizational context. It highlights the significance of Challenges and Opportunities of OB, perception, attribution, learning, organizational change, organizational culture, motivation and leadership.

Course Objectives:

1. To help students interpret and summarize the Determinants and Theories of Personality.
2. To help students acquaint and demonstrate the concepts of Learning and Learning Theories.
3. To illustrate and paraphrase the concept of Perception and Interpersonal Skills.
4. To judge and exhibit the fundamentals of Group Dynamics.

Course Outcomes:

After completion of this course the students will be able to:

CO1: Apply the concept of Organization and Organization Behaviour to the Modern-day Management

CO2: Demonstrate the practical applications of determinants of Personality.

CO3: Interpret and establish the factors affecting Perception and Perceptual Consistency.

CO4: Administer and Record the factors affecting Group Dynamics, Group Behaviour and Group Cohesiveness.

Course Pre-requisites: Basics of Human Resource Management.

Pedagogy: ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction** Meaning - need and importance of organization – classification of organization - prospectus of formal organization - Organizational Behaviour – Nature and Scope – contribution from other discipline.	10 Hrs.	CO1	PO2 & PO7	POS1
Unit-2	**Personality & Learning** Definition - Determinants of personality -	10 Hrs.	CO2	PO2 &	POS1

	Theories of personality – Erickson's personality - Freudian theory and Trait theory - Meaning of learning – Learning process – Learning theory of Organizational Behaviour – Classical - Operant conditioning- Cognitive- Observation Theory.			PO7	
Unit-3	**Attitude & Perception** Meaning – Characteristics - Components and Formation of attitudes - Change in attitude - Barriers to change- How to minimize the barriers. Perception: - Meaning and definition – Need - Factors influencing perception - perceptual consistency - Context and definition - Interpersonal perception.	10 Hrs.	CO3	PO2 & PO7	POS1
Unit-4	**Group Behavior and Group Dynamics** Meaning – Types – Groups in the organization – Group size and status – Influences –Roles and relationship and group behavior – Characteristics – Behavior problem - Group norms – Cohesiveness - feature Effects – Group thinking – Symptoms - Influence and Remedy – Group decision making techniques.	9 Hrs.	CO4	PO2 & PO7	POS1

Reference Books:

1. Organizational Behaviour: Text and Case, Singh, K. 3/e, 2012, New Dehli: Pearson Education.
2. Organizational Behaviour (Text, Cases and Games). Aswathappa, K. (2010). Bangalore: Himalaya
Publication.
3. Behaviour in Organizations, Greenberg, J., & Baron, R. A. (2008).. Pearson Prentice Hall. Nelson, D. L.,
& Quik, J. C. (2008).
5. Organization Behaviour. Thomson South Western. Robbins, S. P., Judge, T. A., & Vohra, N. (2011).

Course Title: Environment and Public Health
Course Code: B20BB2070
Course Description: An environmental studies course advances a student's knowledge in a variety of currently relevant topics such as energy, pollution, and environmental awareness. Sessions often cover how to evaluate and address environmental problems. ... Education focusing on environmental studies can launch several types of careers.

Course Objectives:

1) Imparting basic knowledge and to develop attitude of concern, awareness about the environment and Creating awareness among students to acquire skills for identifying and solving environmental problems
2) To educate students on cause, effects and measures to control environmental pollution and to have interdisciplinary approach in environmental education to build a bridge between environment and technology.

Course Outcomes:

CO1: Understand multidisciplinary nature of environment and linkage between Environment and Health.
CO2: Articulate the interdisciplinary context of environmental issues and Diseases in Contemporary Society
CO3: Understand core concepts and methods of Alternative systems of medicine – Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH).
CO4: Students will have mastered foundational knowledge enabling them to make sound life decisions as well as enter a career in an environmental profession and helps them to know the Environment Management Policies and practices

Course Pre-requisites: Basic Knowledge of Science

Pedagogy: Direct Method & ICT

LTP: 0:0:0

Course type: FC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Linkages between Environment and Health** Understanding linkages between Environment and Public Health Effect of quality of air, water and soil on health. Perspective on Individual health: Nutritional, socio – cultural and developmental aspects, Dietary diversity for good health; Human developmental indices for public health. Climate Change and Implications on Public Health Global warming – Agricultural practices (chemical agriculture) and Industrial technologies (use of non-biodegradable materials like plastics, aerosols, refrigerants, pesticides): Manifestations of Climate change on Public Health-Burning of Fossil fuels, automobile emissions and Acid rain	10Hrs.	CO1	PO7	POS1
Unit-2	**Diseases in Contemporary Society** Definition – need for good health- factors affecting health. Types of diseases – deficiency, infection, pollution diseases-allergies, respiratory, cardiovascular, and cancer	10Hrs.	CO2	PO7	POS1

	Personal hygiene-food – balanced diet. Food habits and cleanliness, food adulterants, avoiding smoking, drugs and alcohol. Communicable diseases: Mode of transmission – epidemic and endemic diseases. Management of hygiene in public places – Railway stations, Bus stands and other public places. Infectious diseases: Role of sanitation and poverty case studies on TB, diarrhea, malaria, viral diseases. Non-communicable diseases: Role of Lifestyle and built environment. Diabetes and Hypertension.				
Unit-3	**Perspectives and Interventions in Public Health** Epidemiological perspective – Disease burden and surveillance; Alternative systems of medicine – Ayurveda, Yoga, Unani, Siddha and Homeopathy (AYUSH); Universal Immunization Programme (UIP); Reproductive health-Youth Unite for Victory on AIDS (YUVA) programme of Government of India. Occupational health hazards-physical chemical and biological, Occupational diseases-prevention and control.	10Hrs.	CO3	PO7	POS1
Unit-4	**Environmental Management Policies and Practices** Municipal solid waste management: Definition, sources, characterization collection and transportation and disposal methods. Solid waste management system in urban and rural areas. Municipal Solid waste rules. Policies and practices with respect to Environmental Protection Act, Forest Conservation Act, Wild life protection Act, Water and Air Act, Industrial, Biomedical and E waste disposal rules.	09Hrs.	CO4	PO7	POS1

Reference Books:

1. Desai R.G. - Environmental studies. Himalaya Pub. House.
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
4. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
5. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
6. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
7. Groom, Martha J. Gary K. Meffe and Carl Ronald carroll Principles of Conservation Biology.

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B20BB2080	**Skill Development Course**	**RULO**	**0**	**0**	**0**	**0**	**4**

THIRD SEMESTER

Course Title: ಕನ್ನಡ – ಐಐಐ

Course Code: B20BB3011

Course Description:
ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ಮೊದಲ ಎರಡು ಸೆಮಿಸ್ಟರ್ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು; ಮೂರು ಮತ್ತು ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್ ಎರಡು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Course Objectives:
ನಾಲ್ಕು ಸೆಮಿಸ್ಟರ್‌ಗಳಲ್ಲಿ ಸಮಗ್ರ ಕನ್ನಡ ಸಾಹಿತ್ಯವನ್ನು ಪರಿಚಯಿಸುವ ಉದ್ದೇಶವನ್ನು ಹೊಂದಿದೆ. ಅದರಂತೆ ಮೂರನೆಯ ಸೆಮಿಸ್ಟರ್‌ನಲ್ಲಿ ನವೋದಯ ಕಾವ್ಯ, ನವ್ಯ ಕಾವ್ಯ, ವಾಣಿಜ್ಯ ಕನ್ನಡ, ವೈಜ್ಞಾನಿಕ ಲೇಖನಗಳು ಮತ್ತು ಏಕಾಂಕ ಸಾಹಿತ್ಯವನ್ನು ಪಠ್ಯವನ್ನಾಗಿ ಆಯ್ಕೆ ಮಾಡಿಕೊಂಡು, ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸದಭಿರುಚಿಯನ್ನು ಮೂಡಿಸಲಾಗುತ್ತದೆ. ಸಾಂಸ್ಕೃತಿಕ ತಿಳುವಳಿಕೆಯ ಜೊತೆಗೆ ವ್ಯಕ್ತಿತ್ವ ವಿಕಸನದ ಕಡೆಗೆ ಗಮನ ನೀಡಲಾಗುತ್ತದೆ.

1. ಭಾಷೆ, ಸಾಹಿತ್ಯ, ಇತಿಹಾಸ ಮತ್ತು ಸಂಸ್ಕೃತಿಗಳನ್ನು ಕನ್ನಡ, ಕರ್ನಾಟಕಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ ಪರಿಚಯಿಸಲಾಗುತ್ತದೆ.
2. ವಿದ್ಯಾರ್ಥಿಗಳ ಸರ್ವತೋಮುಖ ಬೆಳವಣಿಗೆಗೆ ಅನುವಾಗುವಂತೆ ಹಾಗೂ ಅವರಲ್ಲಿ ಮಾನವ ಸಂಬಂಧಗಳ ಬಗ್ಗೆ ಗೌರವ, ಸಮಾನತೆ ಮೂಡಿಸಿ, ಬೆಳೆಸುವ ನಿಟ್ಟಿನಲ್ಲಿ ಪಠ್ಯಗಳ ಆಯ್ಕೆಯಾಗಿದೆ.
3. ಅವರಲ್ಲಿ ಸೃಜನಶೀಲತೆ, ಶುದ್ಧ ಭಾಷೆ, ಉತ್ತಮ ವಿಮರ್ಶಾ ಗುಣ, ನಿರರ್ಗಳ ಸಂಭಾಷಣೆ, ಭಾಷಣ ಕಲೆ ಹಾಗೂ ಬರಹ ಕೌಶಲ್ಯಗಳನ್ನು ಬೆಳೆಸುವುದು ಗುರಿಯಾಗಿದೆ
4. ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ಅನುಕೂಲವಾಗುವಂತಹ ವಿಷಯಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು ಸೂಕ್ತ ಪಠ್ಯಗಳನ್ನು ಆಯ್ಕೆ ಮಾಡಿಕೊಳ್ಳಲಾಗಿದೆ.

Course Outcomes:
ನವೋದಯ ಕಾವ್ಯ, ನವ್ಯ ಕಾವ್ಯ, ವಾಣಿಜ್ಯ ಕನ್ನಡ, ವೈಜ್ಞಾನಿಕ ಲೇಖನಗಳು ಮತ್ತು ಏಕಾಂಕ ನಾಟಕದ ಕಲಿಕೆಯ ಮೂಲಕ ಕಾಲದ ಸ್ಥಿತ್ಯಂತರಗಳನ್ನು ಅದರ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

ಅಔ1:ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಯುತ್ತದೆ.
ಅಔ2: ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳು, ಸಮಸ್ಯೆಗಳನ್ನು ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.
ಅಔ3:ಉತ್ತಮ ಸಂವಹನ ಕಲೆಯನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.
ಅಔ4:ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.

Course Pre-requisites:

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy: Direct method, ICT and Digital support (Links attached), Collaborative and Cooperative learning, Differentiated Instruction,Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**ನವೋದಯ ಕಾವ್ಯ** 1. ಇಳಿದು ಬಾ ತಾಯೆ – ದ.ರಾ. ಬೇಂದ್ರೆ 2. ದೇವರು ರುಜು ಮಾಡಿದನು – ಕುವೆಂಪು 3. ನನ್ನ ನಲ್ಲ– ಮಧುರಚೆನ್ನ	10 Hrs	CO1	PO5, PO8	POS1
Unit-2	**ನವ್ಯ ಕಾವ್ಯ** 1. ನೆಲ ಸಪಾಟಿಲ್ಲ – ಗೋಪಾಲ ಕೃಷ್ಣ ಅಡಿಗ 2. ಇಡದಿರು ನನ್ನ ನಿನ್ನ ಸಿಂಹಾಸನದ ಮೇಲೆ – ಕೆ.ಎಸ್. ನರಸಿಂಹಸ್ವಾಮಿ 3. ಅವ್ವ – ಪಿ. ಲಂಕೇಶ್	10 Hrs.	CO1, CO2	PO5, PO8	POS1
Unit-3	**ವಾಣಿಜ್ಯ ಕನ್ನಡ ವೈಜ್ಞಾನಿಕ ಲೇಖನಗಳು** 1. ಅತಿ ಸಣ್ಣ, ಸಣ್ಣ ಪ್ರಮಾಣದ ಉದ್ಯಮಗಳು ಹಾಗೂ ವಿಶೇಷ ಆರ್ಥಿಕ ವಲಯ (ಎಸ್.ಇ.ಝೆಡ್) – ಮುರುಳಿಧರ ಬಿ ಕುಲಕರ್ಣಿ 2. ಮೊಬೈಲ್ ಬ್ಯಾಂಕಿಂಗ್ ಬಲು ಸುಲಭ – ಮಹೇಶ್ ಚಂದ್ರ 3. ವಿಜ್ಞಾನ ಮತ್ತು ಧರ್ಮ – ಡಾ ಜಿ. ರಾಮಕೃಷ್ಣ	10 Hrs.	CO3, CO4	PO5, PO8	POS1
Unit-4	**ಏಕಾಂಕ:** ಮಾನಿಷಾದ – ಗಿರೀಶ್ ಕಾರ್ನಾಡ್	09 Hrs.	CO3, CO4	PO5, PO8	POS1

Reference Books:

1. ಮುಗಳಿ ರಂ.ಶ್ರೀ., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ಗೀತಾ ಬುಕ್ ಹೌಸ್, ಮೈಸೂರು. 2014
2. ಸೀಮಾತೀತ ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ ಸಂಪುಟ 1,2,3,4,5 ಮತ್ತು 6, ಕುವೆಂಪು ಕನ್ನಡ ಅಧ್ಯಯನ ಸಂಸ್ಥೆ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು. 2014
3. ಡಾ. ಅರವಿಂದ ಮಾಲಗತ್ತಿ, ಸಾಹಿತ್ಯ ಸಂಸ್ಕೃತಿ ಮತ್ತು ದಲಿತ ಪ್ರಜ್ಞೆ, ಪ್ರಕಾಶಕರು ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು. 2014
4. ಡಾ. ಈ.ಎಸ್. ಆಮೂರ, ಕನ್ನಡ ಕಥನ ಸಾಹಿತ್ಯ : ಕಾದಂಬರಿ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2016
5. ದೇಶಪಾಂಡೆ ಎಸ್.ಎಲ್., ಬೇಂದ್ರೆ ಶರೀಫರ ಕಾವ್ಯಾಯಾನ, ಪ್ರಕಾಶಕರು ದೇಸಿ ಪುಸ್ತಕ, ಬೆಂಗಳೂರು. 2013
6. ಕೀರ್ತನಾಥ ಕುರ್ತಕೋಟಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಗಾತಿ, ಪ್ರಕಾಶಕರು ಕುರ್ತಕೋಟಿ ಮೆಮೋರಿಯಲ್ ಟ್ರಸ್ಟ್, ಧಾರವಾಡ. 2009
7. ಶಾಮರಾಯ ತ.ಸು., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ತಳುಕಿನ ವೆಂಕಣ್ಣಯ್ಯ ಸ್ಮಾರಕ ಗ್ರಂಥಮಾಲೆ, ಮೈಸೂರು –2014
8. ಸಂ. ಡಾ! ಸಿ. ಆರ್. ಚಂದ್ರಶೇಖರ್, ಮುಂದಾಳುತನದ ಲಕ್ಷಣಗಳನ್ನು ಬೆಳೆಸಿಕೊಳ್ಳುವುದು ಹೇಗೆ?, ಪ್ರಕಾಶಕರು ನವಕರ್ನಾಟಕ ಪಬ್ಲಿಕೇಷನ್ಸ್ ಪ್ರೈವೆಟ್ ಲಿಮಿಟೆಡ್. 2010
9. ಆಧುನಿಕ ಕನ್ನಡ ಕಾವ್ಯ ಭಾಗ–2, ಕುವೆಂಪು ಕನ್ನಡ ಅಧ್ಯಯನ ಸಂಸ್ಥೆ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು. 2004
10. ಶಿವರುದ್ರಪ್ಪ ಜಿ.ಎಸ್. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಮೀಕ್ಷೆ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 201

Course Title: Hindi
Course Code: B20BB3012
Course Description: यह पाठ्यक्रम नौसिखिया अपनी भाषा की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक प्रक्रियाओं द्वारा समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

CO1: सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |

CO2: साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |

CO3: समाज में अंतर्निहित पद्दतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |

CO4: साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है

Course Pre-requisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |
- अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है |

Pedagogy: ICT and Digital support, Collaborative and Cooperative learning, Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**इकाई - 1** नाटक - आधे – अधूरे - मोहन राकेश नाटक विधा का परिचय – आधे अधूरे - प्रथम अंक	10Hrs.	CO1, CO2	PO5&8	POS1
Unit-2	**इकाई - 2** नाटक - आधे - अधूरे – मोहन राकेश आधे – अधूरे - वितीय अंक	10Hrs.	CO1, CO2	PO5&8	POS1
Unit-3	**इकाई -3** नाटक - आधे – अधूरे - मोहन राकेश आधे – अधूरे - तृतीय अंक	10Hrs.	CO3, CO4	PO5&8	POS1
Unit-4	**इकाई -4** नगदी रहित व्यवहार अ 1 चेक तथा बैंक प्रणाली द्वारा भुगतान 2 कम्प्युटर इंटरनेट प्रणाली द्वारा भुगतान आ 3 स्वैप (POS) मशीन द्वारा भुगतान	09Hrs.	CO3, CO4	PO5&8	POS1

		4	भ्रमणध्वनि द्वारा भुगतान				
	इ	5	ए टी एम द्वारा भुगतान				
		6	विभिन्न बैंकों के ऐप द्वारा भुगतान				

Reference Books:

1. नाटक - आधे – अधूरे - मोहन राकेश
2. हिन्दी नाटक उद्भव और विकास –दशरथ ओझा
3. .हिन्दी साहित्य का इतिहास नागेन्द्र .डॉ -
4. आधुनिक हिन्दी साहित्य का इतिहास बच्चन सिंह .डॉ -
5. हिन्दी साहित्य का नवीन इतिहास लाल साहब सिंह .डॉ -
6. शुद्ध हिन्दी कैसे बोले कैसे लिखेपृथ्वीनाथ पाण्डे -
7. हिन्दी नाटक और रंगमंच – डॉ.रामकुमार वर्मा
8. कंप्यूटर सूचना प्रणाली विकास – रामबंसल वाज्ञाचर्या
9. कंप्यूटर के भाषिक अनुपयोग - विजयकुमार मल्होत्रा

Course Title: Additional English – III

Course Code: B20BB3013

Course Description: This 2-credit course allows the learners to explore the various socio-political aspects represented in literature. The concepts discussed in the course provide learning exposure to real life scenarios. The course is designed to develop critical thinking ability among learners, through the socio-political aspects discussed in literature. Thus, the aim is to produce responsible and sensitive individuals.

Course Objectives:

1. To outline the global and local concerns of gender and identity.
2. To identify the complexities of human emotions through literature.
3. To assess the struggles of human survival throughout history.
4. To compare and contrast between the various dimensions of childhood.

Course Outcomes:

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

CO1: Evaluate the pressing gender issues within our society.
CO2: Criticize human actions through a humane and tolerant approach.
CO3: Perceive the human conflicts with an empathetic perspective.
CO4: To disprove the assumption of a privileged childhood.

Pre requisites: The student must possess fair knowledge of language, literature and society.

Pedagogy: Direct method / ICT / Collaborative Learning / Flipped Classroom.

LTP: 2:1:0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Gender & Identity** Anne Sexton – Consorting with Angels Eugene Field – The Doll's Wooing Vijay Dan Detha – Double Life Charlotte Perkins Gilman – The Yellow Wallpaper	10Hrs.	CO1	PO5	 POS1
Unit-2	**Love & Romance** Literature: Tadeusz Rozewicz – Pigtail Jyoti Lanjewar – Mother Sowvendra Shekhar Hansda – The Adivasi Will Not Dance Harriet Jacobs – Excerpt from Incidents in the Life of a Slave Girl Language: Prefix and Suffix	10Hrs.	CO2	PO5	 POS1
Unit-3	**War & Trauma** Lord Alfred Tennyson – The Charge of the Light Brigade TaufiqRafat – The Medal Guy de Maupassant – Two Friends Sadaat Hasan Manto – Toba Tek Singh	10Hrs.	CO3	PO5&8	 POS1
Unit-4	**Children's Literature** William Blake – The Chimney Sweeper D.H. Lawrence – Discord in Childhood Anna Sewell – The Black Beauty (Extract) Rudyard Kipling – The Jungle Book (Extract)	09Hrs.	CO4	PO8	 POS1

Reference Books:

1. Sexton, Anne. The Complete Poems. Houghton Mifflin, 1999.
2. Namjoshi, Suniti. Feminist Fables. Spinifex Press, 1998.
3. Vanita, Ruth & SaleemKidwai (ed.) Same Sex Love in India. Penguin India, 2008.
4. Gilman, Charlotte Perkins. The Yellow Wallpaper. Rockland Press, 2017.
5. Gale, Cengage Learning. A Study Guide for Alfred Noyes's "The Highwayman". Gale, Study Guides, 2017. (Kindle Edition Available)
6. Shakespeare, William. Poems and Sonnets of William Shakespeare. Cosimo Classics, 2007.
7. Stockton, Frank Richard. The Lady, or the Tiger? Create space Independent Publications, 2017.
8. Wilde, Oscar. The Collected Works of Oscar Wilde. Wordsworth Editions Ltd., 1997.
9. Tennyson, Lord Alfred. The Complete Works of Alfred Tennyson. Forgotten Books, 2017.
10. Blake, William Erdman, David V. (ed.). The Complete Poetry and Prose (Newly revised ed.). Anchor Books, (1988).
11. Maupassant, Guy de. Guy de Maupassant-The Complete Short Stories. Projapati, 2015.
12. Manto, Sadaat Hasan. Manto: Selected Short Stories. RHI, 2012.
13. Ricks, Christopher. Metaphysical Poetry. Penguin, 2006.

14. Sewell, Anna. The Black Beauty. Maple Press, 2014.
15. Kipling, Rudyard. The Jungle Book. Amazing Reads, 2018.

Course Title: Cost Accounting

Course Code: B20BB3020

Course Description: This course consists of a discussion of cost accounting concepts and objectives, an in-depth study of cost accounting systems and accumulation procedures and a search into the elementsSC of material, labor and factory overhead costs.

Course Objectives:

1. To understand the basic concepts and processes used to determine product cost.
2. To be able to interpret cost accounting statement
3. To be able to analyze and evaluate information for cost ascertainment, planning, control and decision making
4. To be able to solve simple cases

Course Outcomes:

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

CO1: Aimed to familiarize the concept of cost accounting & Helps to gather knowledge on preparation of cost sheet in its practical point of view

CO2: To facilitate the idea and meaning of material control with pricing methods

CO3: Develop the knowledge about remuneration and incentives

CO4: To introduce the concept of overhead cost

Course Pre-requisites: Financial accounting

Pedagogy: Direct method and ICT

LTP: 2:0:1

Course type: SC

Contact Hours: 39 Hrs.

Units	Detailed Syllabus	Contact hours	CO	PO	PSO
Unit-1	**Introduction to Cost Accounting** Introduction – Meaning & Definition of Cost, Costing and Cost Accounting – Objectives of Costing - Comparison between Financial Accounting and Cost Accounting – Application of Cost Accounting – Designing and Installing a Cost Accounting System – Cost Concepts - Classification of Costs – Cost Unit – Cost Center – Elements of Cost – Preparation of Cost Sheet – Tenders and Quotations.	10 Hrs.	CO 1	PO2 & PO8	POS2 & POS3

Unit-2	**Material Cost Control** Meaning – Types – Direct Material – Indirect Material - Material Control – Purchasing Procedure – Store Keeping – Techniques of Inventory Control – Setting of Stock Levels – EOQ – ABC Analysis – VED Analysis – Just In-Time – Perpetual Inventory System – Documents used in Material Accounting - Methods of Pricing Material Issues – FIFO – LIFO – Weighted Average Price Method and Simple Average Price Method	10 Hrs.	CO 2	PO2 & PO8	POS2 & POS3
Unit-3	**Labour Cost Control** Meaning – Types – Direct Labor – Indirect Labor – Timekeeping – Time booking – Idle Time – Overtime – Labor Turn Over. Methods of Labor Remuneration - Time Rate System – Piece Rate System– Incentive Systems – Halsey plan – Rowan Plan – Taylor's differential Piece Rate System and Merrick"sDifferential Piece Rate System – Problems	9 Hrs.	CO 3	PO2 & PO8	POS2 & POS3
Unit-4	**Overhead Cost Control** Meaning and Definition – Classification of Overheads – Procedure for Accounting and Control of Overheads – Allocation of Overheads – Apportionment of Overheads – Primary Overhead Distribution Summary – Secondary Overhead Distribution Summary – Repeated Distribution Method and Simultaneous Equations Method – Absorption of Factory Overheads – Methods of Absorption – Machine Hour Rate – Problems.	10 Hrs	C04	PO2 & PO8	POS2 & POS3

Reference Books:

- M.C Shukla T.S Grewal- Cost Accounting 2nd edition 2017- S chand&Company
- Srikant M Datar Madhav V Rajan- Cost Accounting -17th edition 2018- Pearson Publications
- P.C Tulsian Bharat Tulsian- Cost Accounting- 9th edition 2016- S chand&company
- M.L. Agarwal: Cost Accounting, Sahithya Bhawan Publications.
- M. N. Arora: Cost Accounting, HPH

Course Title: Financial Management
Course Code: B20BB3030
Course Description: Financial Management is an introductory finance course designed to make students understand the basic finance concepts. The course involves studies on decision-making utilizing financial resources available to the firm from the perspective of the manager

Course Objectives:

1. To help the students to develop cognizance of the importance of Financial Management in corporate valuation
2. To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporates in different manner.
3. To enable students to synthesize related information and evaluate options for most logical and operational solutions such that they would be able to predict and control Debt Equity incurrence and improve results

Course Outcomes:

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

CO1: To understand theoretical framework of financial management and role of financial managers.

CO2: Apply the Leverages and EBIT and EPS analysis associated with Financial Data in the Corporate.

CO3: Demonstrate how the concepts of Financial Management and investment, financing and dividend policy decisions could integrate while identification and resolution of problems pertaining to various sectors.

CO4: Estimation of Working Capital Requirements of the business and framing inventory and credit policies.

Course Pre-requisites: Basic Knowledge of fundamentals of finance.

Pedagogy: Direct method and ICT

LTP: 3:0:1

Course type: HC

Contact Hours: 52 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to financial management:** Introduction, Meaning and Definition of Financial Management - Functions of Financial Management- Inter-relationship of Finance Functions or Decisions - Liquidity Vs. Profitability- Role of Finance Manager-Financial Instruments: Equity Shares, Preference Shares, Right Issues; Debts – Objectives of Financial Management - Criticism of Wealth Maximization- Conflict of Goals	12 Hrs.	CO 1	02	POS1
Unit-2	**Investment Decision** Capital Budgeting: Features of Capital Budgeting, Importance of Capital Budgeting; Evaluations Techniques of Projects: Traditional Techniques: Pay Back Period - Accounting Rate of Return - Time Adjusted Techniques: Net Present Value - Internal Rate of Return – Profitability Index - Risk and Uncertainty in Capital Budgeting (Simple	14 Hrs.	CO 2	02	POS2 & POS3

	Problems)				
Unit-3	**Financing Decision and Dividend Decisions** Meaning and Definition of Capital Structure - Factors Determining the Capital structure - Leverage Analysis: Operating Leverage, Financial Leverage - Cost of Capital - Significance of Cost of Capital - Computation of Cost of Capital – EPS - EBIT Analysis; Dividend Policy: Dividend decision and valuation of Firm, Determinants of Dividend Policy, Types of Dividends.	14 Hrs.	CO 3	02	POS2 & POS3
Unit-4	**Working Capital Decisions** Introduction - Working Capital Cycle, Factors Effecting Working Capital, Importance of Adequate Working Capital, Financing of Working Capital, Determining Working Capital Financing Mix, Working Capital Analysis, Estimation of Working Capital Requirements; Receivables Management: Meaning and Definition - Dimensions of Receivables Management - Costs of Maintaining Receivables.	12 Hrs.	C04	02	POS2 & POS3

Reference Books:

1. Financial Management: Text and Problems by M Y Khan & P K Jain, Publisher: TMH, New Delhi.
2. Financial Management Theory & Practice by Prasanna Chandra, Publisher: TMH, New Delhi.
3. Financial Management by I M Pandey, Publisher: Vikas Publishing House, New Delhi.
4. Fundamentals of Financial Management by Van Horne, Publisher: Prentice Hall of India.
5. Advanced Accounting by Gupta R.L. and Radha Swamy M., Publisher: Sultan Chand & Sons, New Delhi.
6. Financial Management by Kishore R., Publisher: Taxman's Publishing House, New Delhi.
7. Financial Management by CA.C. Rama Gopal, The New Age International Publishers, New Delhi

Course Title: Service Sector Management
Course Code: B20BB3040

Course Description: The course explores the dimensions of successful service firms. It prepares students for enlightened management and suggests creative entrepreneurial opportunities. Outstanding service organizations are managed differently than their "merely good" competitors. Actions are based on totally different assumptions about the way success is achieved. Beginning with the service encounter, service managers must blend marketing, technology, people, and information to achieve a distinctive competitive advantage. The material will integrate operations, marketing, strategy, information technology and organizational issues. Lastly the service sector is the fastest-growing sector of the economy; the course is intended to help students discover entrepreneurial opportunities.

Course Objectives:

1. To study "breakthrough" services in order to understand the operations of successful service firms that can be benchmarks for future management practice.
2. To develop an understanding of the "state of the art" of service management thinking.
3. To develop an awareness of the opportunities that information technology can have for enhancing service firm's competitiveness.
4. To appreciate the organizational significance of managing the service encounter to achieve internal and external customer satisfaction.

Course Outcomes:

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

CO1: Know in detail about the Service Sector and apply the 7 P's of Service Marketing.
CO2: Understand the consumer behaviour in Service Sector.
CO3: Set standard and measure service quality and productivity.
CO4: Know the issues and challenges of HR.

Course Pre-requisites: Knowledge of Human Resources Management

Pedagogy: Direct Method and ICT

LTP: 2:1:0

Course type: SC

Contact Hours:39 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to services and service sector Management** Services – Meaning, Features, Classification of Services: End User, Degree of Tangibility, People Based Services, Expertise Required, Orientation Towards Profit, By Location, Service Sector Management – Meaning Significance of Service Sector, Reasons for Growth in Service Sector	9 Hrs.	CO1	PO6	POS1
Unit-2	**Managing Service Operations** Service Organization – Importance of Layout and Design of Service Organization, Servicescape, Service Culture in Organization – Meaning, Developing Service Culture in Organization, Managing the Service Profit Chain, Managing Queues, Managing Capacity and Demand, Competing on Service Quality, Achieving, Delivering Customer Service, Process Innovation, Service Outsourcing, Exploiting. The Virtual Value	10 Hrs.	CO2	PO6	POS1

	Chain, Service Process Analysis, Cultural Transferability				
Unit-3	**Relationship Marketing and Customer Service** Meaning, Need and Importance in Service Sector Organizations, Six Market Model, Role of Service Employee, Role of Customers in Service Process, Customers as Productive Resources, Delivering Customer Service,Total Customer Satisfaction, Franchising with Quality, Customer Satisfaction, Customers as Contributors to Service Quality, Customers as Competitors, Service Encounter and Moment of Truth –Meaning, Nature, Elements of Service Encounter	10 Hrs.	CO3	PO6	POS1
Unit-4	**Issues and Challenges of HR in Service Sector Quality Issues in Services** Meaning and Dimensions of Service Quality, The Service – Gap Model, Reasons and Strategies to fill the Gaps, Delivering Services through Agents and Brokers – Meaning, Advantages, Challenges, Strategies for Effective Service Delivery through Agents and Brokers, HRM in Public Sector Organizations and Non – Profit Sector in India, Issues and Challenges of HR in Specific Services	10 Hrs.	CO4	PO6	POS1

Reference Books:

1. Valerie Zeithaml & Mary Jo Bitner; Services Marketing – Tata-McGraw–Hill
2. Service Management – Operations, Strategy, Information Technology, 7e, James A Fitzsimmons and Mona J Fitzsimmons, McGraw Hill Education, 2017
3. Service Management: Strategy and leadership in service business, 3rd Edition, Richard Norman, Wiley
4. Ravi Shankar; Services Marketing Text & Readings, Indian Perspective; Excel Books.
5. Leonard L berry and A Parasuraman; Marketing Services: Competing through Quality; Macmillan India Ltd.

Course Title: BUSINESS ETHICS AND CORPORATE GOVERNANCE

Course Code: B20BB3050

Course Description: The course aims to develop an understanding of the underlying concepts of Corporate Governance, and business ethics which are relevant to the contemporary business environment. It is designed to foster candidates' understanding of the ethical influences on economic, financial, managerial and environmental aspects of business. The course further aims to develop a candidate's ability to critically analyses ethical issues in business. This course reviews different regulatory processes essential to the understanding of the principles of corporate governance in India. Business ethics and corporate governance is the study of to understand Business ethics in order to implement the best practices of business ethics.

Course Objectives:

1To understand the Business Ethics and to provide best practices of business ethics.
2. To learn and Practice the Professional Ethics, Values and Moral at the Workplace.
3. To develop various Ethics in Functional Area and Practice.
4. To understand the various rules and regulation and committees with respect Corporate Governance.

Course Outcomes:

After the completion of the course, students will be able to:
CO1Articulate issues in business ethics, the ethical business environment and their potential effect on personal, managerial and corporate decisions.
CO2: Apply the Professional Ethics, Values and Moral at the Workplace.
CO3: Critically evaluate the concepts and mechanics of Ethics in Functional Area.
CO4: Evaluate the roles and responsibilities of executive directors, non-executive directors, auditors and company secretaries in ensuring effective corporate governance.

Course Pre-requisites: Knowledge Business Activities and their financial needs.

Pedagogy: Chalk and Talk and Blended learning

LTP: 2:1:0

Course type: SC

Contact Hours: 39Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Business Ethics**: Meaning of Ethics– Objectives - Types of Ethics – Characteristics –Nature of Ethics- Ethical Theories- Ethical Decision Making- Definition of Business Ethics-Arguments for and against business ethics –Scope of Business Ethics – Nature of Business Ethics-Factors influencing Business Ethics – Importance of Business Ethics - Code of Ethics- Codes of Conduct- unethical behavior and its impact on business.	10 Hrs.	1	PO3 & PO4	POS1
Unit-2	**Professional Ethics, Values and Moral at the Workplace**: introduction- Significance of Ethics at the Workplace- Importance of Professional Ethics - Relationship between Ethics, Values and Moral- Leadership Values and Workplace Ethics-Code of conduct of different Professionals- Examples of professional ethics: medical, journalistic, military,	9 Hrs.	2	PO3 & PO4	POS1

	lawyer Ethics, ethics of the social worker. Reasons of crisis of professional ethics and possibility of its Permission.				
Unit-3	**Ethics in Functional Area:** Ethical aspects in marketing: Ethics in Marketing-Reasons for unethical Practices – Ethics in regulations in pricing-Ethics in Personal Selling-Ethical social issues in Advertising- Ethical consumerism- Ethics in HRM: Privacy Issues- Ethical Implications of variation in HRM practices – Individualism vs. Collectivism in HRM practices- Sexual harassment – Ethics in Finance: Accountability and Acquisitions- Insider trading – Accounting fraud.	10 Hrs.	3	PO3 & PO4	POS1
Unit-4	**Corporate Governance:** Meaning- Definition- Importance of Corporate Governance- Objectives of Corporate Governance – Theories of Corporate Governance- Models of Corporate Governance- Indian Committees and guidelines on CG -The CII – Naresh Chandra Committee- J.J. Irani Committee – Narayana Murthy Committee — Kumara Mangalam Birla Committee- Kotak Mahindra Committee on CG.	10 Hrs.	4	PO3 & PO4	POS1

Reference Books:

1. Murthy CSV: Business Ethics, Himalaya Publishing House, 2010.
2.Alexander Brink, Corporate Governance and Business Ethics, Springer Science & Business Media, 12-Aug-2011.
3.A. C. Fernando, Business Ethics and Corporate Governance, Pearson Education India, 2011.
4.Jeremy Moon, Marc Orlitzky, Glen Whelan, Corporate Governance and Business Ethics. Edward Elgar, 2010
5.Anil Kumar Jyotsna Rajan Arora, Corporate Governance Business Ethics& CSR, International Book House Pvt.Ltd.

Course Title: Indian Financial System
Course Code: B20BB3060
Course Description: Students learn about the fundamentals of financial institutions and Markets in India. And also helps to learn about the financial system in the economy and different types of financial instruments, financial markets, major financial institutions.
Course Objectives: 1. Gain basic knowledge of Indian financial system. 2. Understand the significance and functions of financial markets 3. Understand the functioning of financial and regulatory institutions. 4. Explore the emerging financial services.

Course Outcomes:
After the completion of the course, students will be able to:

CO1: Understand the concept of financial markets and its role in economic development.
CO2: Analysis the nature of financial markets.
CO3: Identify different financial and regulatory institutions and its functions.
CO4: Enumerate the functions of different financial services.

Course Pre-requisites: Knowledge Business Activities and their financial needs.

Pedagogy: Direct Method/ ICT

LTP: 2:1:0

Course type: SC

Contact Hours: 39Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Overview of Indian Financial System** Introduction – Meaning -Definition- Functions-Importance-Structure – Financial Institutions, Financial Markets-Financial Instruments-Financial Services- Financial System and Economic Development.	9 Hrs.	1	PO6	POS1
Unit-2	**Financial Markets** **Money Market:** Meaning-Features-Functions-Importance-Structure of Money market- Money market Instruments- Money market mutual funds-Recent development of Money market. **Capital Market:** Concept of Security Market, Primary & Secondary Markets-Functions & Role, Functionaries of Stock Exchanges-Brokers, Sub-Brokers, Jobbers, Consultants, Institutional Investors & NRIs – Stock exchanges in India.	10 Hrs.	2	PO6	POS1
Unit-3	**Financial and regulatory Institutions:** Financial Institutions: Role, Classification and functions of-Banking financial Institutions and Non-Banking financial Institutions-Commercial Bank, IFCI, IDBI, ICICI, SFC-Investment Intuitions -UTI, GIC, LIC. Regulatory Institutions: RBI-Objective, Functions, Role of RBI in credit control. SEBI-Objectives, Functions, Role in Primary market and Secondary market.	10 Hrs.	3	PO6	POS1
Unit-4	**Financial Instruments and services:** Concepts and characteristics, features of various financial instruments. **Emerging financial services:** leasing, Hire – Purchasing, Marchant Banking, Depository, Credit rating- Mutual funds.	10 Hrs.	4	PO6	POS1

Reference Books:

1. Khan, M.Y., Indian Financial System, 11th Edition, Tata Mc Graw Hill, New Delhi.
2. H.R Machiraju, Indian Financial System, 5th Edition, Vikas Publications.
3. Gordon, E., and Nataraja, K., Financial Markets and Service,11th Edition, Himalaya Publications, Mumbai
4. Gupta, S.K., and Nisha Aggarwal, Financial Services,6th Revised Edition, Kalyani Publishers, New Delhi.
5. L.M. Bhole, Financial Insitution and Markets, 6th Edition, Tata Mc Graw Hill, New Delhi.

Course Title: Career Planning and Development

Course Code: B20BB3070

Course Description: The purpose of this course is to provide transfer and career students with instruction in the career planning process directly related to the selection of major industries and ultimately the world of work. Topics include a comprehensive skills assessment, identification of work and personal values, career interests, work and learning styles, and personality types related to academic success.

Course Objectives:

1. The students will develop an operational understanding of the components involved in career development programs.
2. The students will develop and understanding of the major career development theories and decision-making models.
3. The students will become acquainted with the major career assessment instruments and techniques.
4. The students will develop leadership skills and communication skills.

Course Outcomes:

After the completion of the course, students will be able to:
CO1Understand the concept CPD and its applications
CO2: Define and relate the recent trends in CPD
CO3: Understand the stages of CPD.
CO4: Understand the Presentation and tie management skills.

Course Pre-requisites: Basic job description

Pedagogy: Direct Method/ ICT

LTP: 3:1:0

Course type: OE

Contact Hours: 52Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction Career Planning** Career – Meaning – Definition - Why career development? -Forces that enable and lead to career development -Major stages of career development - Novation's' Model- Individual's perspective to career development. -Schein's Model – stages of career development.	13 Hrs.	1	2	POS1
Unit-2	**Career Anchors and Values** Career Movement - Factors that affect career choices - Holland's theory of vocational	13 Hrs.	2	2	POS1

	personalities in Work environments**.**					
Unit-3	**Career Appraisal** Instruments used - MBTI etc. - Career coaching and career canters - Career counselling - Career counselling competencies.	13 Hrs.	3	**2**	POS1	
Unit-4	**Professional Career Development** Planning process- steps - Modern Challenges in careers - plateau employees etc. Job Enrichment: Responsibilities of Organizations and employees in career planning. Corporate Offerings: Individual and Team Motivation - Confidence Building - public speaking skills - Leadership skills Development - Effective Communication - Time Management - Building Presentation Skills.	13 Hrs.	4	**2**	POS1	

Reference Books:

1. Business Communication –From Process to product, Boxman joel & Barachaw, Dryden Press, Chicago.
2. Effective Business Communications, Murphy Herta A & Peck, Tata McGraw-Business Communication-Principles & Application.
3. P. Subba Rao, Personnel & Human Resource Management.
4. Successful Business Communication, TreeceMalra, Allyn and Bacon, Boston
5. V.S.P Rao, Human Resource Management, Excel Books

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B20BB3080	**Skill Development Course**	**RULO**	**0**	**0**	**0**	**0**	**4**

FORTH SEMESTER

Course Title: ಕನ್ನಡ – ಖಗಿ
Course Code: B20BB4011
Course Description: ಭಾಷೆಯನ್ನು ಮಾತನಾಡುವ ಬರೆಯುವ ಕೌಶಲ್ಯ, ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಸ್ಥೂಲವಾಗಿ ಪರಿಚಯಿಸುವ ಮೂಲಕ ವಿದ್ಯಾರ್ಥಿಗಳ ವ್ಯಕ್ತಿತ್ವ ವಿಕಾಸ ಹಾಗು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳನ್ನು ಗಮನದಲ್ಲಿಟ್ಟುಕೊಂಡು, ಪ್ರಸ್ತುತ ಸಂದರ್ಭಕ್ಕೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸಲು ಪಠ್ಯವನ್ನು ರೂಪಿಸಲಾಗಿದೆ. ಸಾಹಿತ್ಯ, ಕಲೆ, ವಾಣಿಜ್ಯ, ಆಡಳಿತಾತ್ಮಕ ಮತ್ತು ವಿಜ್ಞಾನದ ವಿಚಾರಗಳಿಗೆ ಒತ್ತನ್ನು ನೀಡಲಾಗಿದೆ. ಇದು ಮೊದಲ ಎರಡು ಸೆಮಿಸ್ಟರ್ ಮೂರು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು; ಮೂರು ಮತ್ತು ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್ ಎರಡು ಕ್ರೆಡಿಟ್‌ಗಳನ್ನು ಹೊಂದಿದೆ.

Course Outcomes:

ನವೋದಯ ಕಾವ್ಯ, ನವ್ಯ ಕಾವ್ಯ, ವಾಣಿಜ್ಯ ಕನ್ನಡ, ವೈಜ್ಞಾನಿಕ ಲೇಖನಗಳು ಮತ್ತು ಏಕಾಂಕ ನಾಟಕದ ಕಲಿಕೆಯ ಮೂಲಕ ಕಾಲದ ಸ್ಥಿತ್ಯಂತರಗಳನ್ನು ಅದರ ಒಳನೋಟಗಳನ್ನು ಬೆಳೆಸುತ್ತದೆ.

ಅಔ1:ಸಾಮಾಜಿಕ, ರಾಜಕೀಯ, ಧಾರ್ಮಿಕ, ಸಾಂಸ್ಕೃತಿಕ, ಪರಿಸರ ಹಾಗೂ ಲಿಂಗಸಂಬಂಧಿ ವಿಚಾರಗಳೆಡೆ ಗಮನ ಹರಿಸುವುದರೊಂದಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಚರ್ಚಾ ಮನೋಭಾವವು ಬೆಳೆಯುತ್ತದೆ.

ಅಔ2: ಜೀವನದಲ್ಲಿ ಬರುವ ಅಭಿಪ್ರಾಯ ಬೇಧಗಳು, ಸಮಸ್ಯೆಗಳನ್ನು ಆಧುನಿಕ ಸಂದರ್ಭದಲ್ಲಿ ಮಾನವೀಯತೆಯೊಂದಿಗೆ ನಿರ್ವಹಿಸುವಂತೆ ಪ್ರೇರೇಪಿಸುತ್ತದೆ.

ಅಔ3:ಉತ್ತಮ ಸಂವಹನ ಕಲೆಯನ್ನು ಬೆಳೆಸುವ ಉದ್ದೇಶವನ್ನು ಈಡೇರಿಸುತ್ತದೆ.

ಅಔ4:ಸಂಶೋದನಾ ಮನೋಭಾವ ಮತ್ತು ಸ್ಪರ್ಧಾತ್ಮಕ ಪರೀಕ್ಷೆಗಳಿಗೆ ವಿದ್ಯಾರ್ಥಿಗಳನ್ನು ಸಜ್ಜುಗೊಳಿಸುತ್ತದೆ.

Course Pre-requisites:

- ಕನ್ನಡ ಭಾಷೆಯ ಬಗೆಗೆ ಪ್ರಾಥಮಿಕ ತಿಳುವಳಿಕೆ ಅಗತ್ಯ..
- ಭಾಷೆಯನ್ನು ಓದಲು ಮತ್ತು ಬರೆಯಲು ತಿಳಿದಿರಬೇಕು.
- ಪದವಿ ಪೂರ್ವ ಶಿಕ್ಷಣದಲ್ಲಿ ಕನ್ನಡ ಭಾಷೆಯನ್ನು ಓದಿರಬೇಕು.

Pedagogy: Direct method, ICT and Digital support (Links attached), Collaborative and Cooperative learning, Differentiated Instruction, Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**ದಲಿತ ಬಂಡಾಯ ಕಾವ್ಯ** 1. ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು – ಸಿದ್ದಲಿಂಗಯ್ಯ 2. ಇಲ್ಲ ಬಿಡುಗಡೆ ನಮಗೆ– ವೀ. ಚಿಕ್ಕವೀರಯ್ಯ 3. ಮಗು ಮತ್ತು ಹಣ್ಣುಗಳು – ಹೆಚ್.ಎಸ್.. ಶಿವಪ್ರಕಾಶ್	8Hrs.	CO1, CO2	PO5, PO8	POS1
Unit-2	**ಸ್ತ್ರೀವಾದಿ ಮತ್ತು ಸಮಕಾಲೀನ ಕಾವ್ಯ** 1. ತಡೆ – ಚ ಸರ್ವಮಂಗಲ 2. ಧ್ಯಾನಸ್ತ ಬಂಗಲೆಗಳು – ವಿ ಆರ್. ಕಾರ್ಪೆಂಟರ್ 3. ಟ್ರಯಲ್ ರೂಮಿನ ಅಪ್ಸರೆಯರು– ಭುವನ ಹಿರೇಮಠ	8Hrs.	CO1, CO2	PO5, PO8	POS1
Unit-3	**ಆಡಳಿತಾತ್ಮಕ ಕನ್ನಡ ಮತ್ತು ವೈಜ್ಞಾನಿಕ ಲೇಖನಗಳು** 1. ಪತ್ರಲೇಖನ ಮತ್ತು ವರದಿಗಳ ತಯಾರಿ 2. ವಿಜ್ಞಾನ ಸಂವನಕ್ಕೆ ಆಧುನಿಕ ತಂತ್ರಜ್ಞಾನದ ಸವಲತ್ತುಗಳು – ಟಿ ಜಿ ಶ್ರೀನಿಧಿ 3. ವಿಜ್ಞಾನ ಮತ್ತು ಸಮಾಜ – ಹೆಚ್ ನರಸಿಂಹಯ್ಯ	7Hrs.	CO3, CO4	PO5, PO8	POS1
Unit-4	**ಕಾದಂಬರಿ** 1. ಕಾಡು – ಶ್ರೀಕೃಷ್ಣ ಆಲನಹಳ್ಳಿ	7Hrs.	CO3, CO4	PO5, PO8	POS1

Reference Books:

1. ಮುಗಳಿ ರಂ.ಶ್ರೀ., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ಗೀತಾ ಬುಕ್ ಹೌಸ್, ಮೈಸೂರು. 2014
2. ಸೀಮಾತೀತ ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ ಸಂಪುಟ 1,2,3,4,5 ಮತ್ತು 6, ಕುವೆಂಪು ಕನ್ನಡ ಅಧ್ಯಯನ ಸಂಸ್ಥೆ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು. 2014
3. ಡಾ. ಅರವಿಂದ ಮಾಲಗತ್ತಿ, ಸಾಹಿತ್ಯ ಸಂಸ್ಕೃತಿ ಮತ್ತು ದಲಿತ ಪ್ರಜ್ಞೆ, ಪ್ರಕಾಶಕರು ಕನ್ನಡ ಸಾಹಿತ್ಯ ಪರಿಷತ್ತು, ಬೆಂಗಳೂರು. 2014
4. ಡಾ. ಈ.ಎಸ್. ಆಮೂರ, ಕನ್ನಡ ಕಥನ ಸಾಹಿತ್ಯ : ಕಾದಂಬರಿ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2016
5. ದೇಶಪಾಂಡೆ ಎಸ್.ಎಲ್., ಬೇಂದ್ರೆ ಶರೀಫರ ಕಾವ್ಯಾಯಾನ, ಪ್ರಕಾಶಕರು ದೇಸಿ ಪುಸ್ತಕ, ಬೆಂಗಳೂರು. 2013
6. ಕೀರ್ತನಾಥ ಕುರ್ತಕೋಟಿ, ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಂಗಾತಿ, ಪ್ರಕಾಶಕರು ಕುರ್ತಕೋಟಿ ಮೆಮೋರಿಯಲ್ ಟ್ರಸ್ಟ್, ಧಾರವಾಡ. 2009
7. ಶಾಮರಾಯ ತ.ಸು., ಕನ್ನಡ ಸಾಹಿತ್ಯ ಚರಿತ್ರೆ, ಪ್ರಕಾಶಕರು ತಳುಕಿನ ವೆಂಕಣ್ಣಯ್ಯ ಸ್ಮಾರಕ ಗ್ರಂಥಮಾಲೆ, ಮೈಸೂರು –2014
8. ಸಂ. ಡಾ! ಸಿ. ಆರ್. ಚಂದ್ರಶೇಖರ್, ಮುಂದಾಳುತನದ ಲಕ್ಷಣಗಳನ್ನು ಬೆಳೆಸಿಕೊಳ್ಳುವುದು ಹೇಗೆ?, ಪ್ರಕಾಶಕರು ನವಕರ್ನಾಟಕ ಪಬ್ಲಿಕೇಷನ್ಸ್ ಪ್ರೈವೇಟ್ ಲಿಮಿಟೆಡ್. 2010
9. ಆಧುನಿಕ ಕನ್ನಡ ಕಾವ್ಯ ಭಾಗ–2, ಕುವೆಂಪು ಕನ್ನಡ ಅಧ್ಯಯನ ಸಂಸ್ಥೆ, ಮೈಸೂರು ವಿಶ್ವವಿದ್ಯಾನಿಲಯ, ಮೈಸೂರು. 2004
10. ಶಿವರುದ್ರಪ್ಪ ಜಿ.ಎಸ್. ಕನ್ನಡ ಸಾಹಿತ್ಯ ಸಮೀಕ್ಷೆ, ಪ್ರಕಾಶಕರು ಸ್ವಪ್ನ ಬುಕ್ ಹೌಸ್, ಬೆಂಗಳೂರು. 2013

Course Title: Hindi

Course Code: B20BB4012

Course Description:

यह पाठ्यक्रम नौसिखिया अपनी भाषा की क्षमता का विकास करने हेतु तथा विभिन्न साहित्यिक प्रक्रियाओं द्वारा समाज, संस्कृति एवं जीवन के मूल्यों को समझने हेतु अभिकल्पित है |

Course Objectives:

1. संदर्भानुसार उचित भाषा का प्रयोग करने की दक्षता को छात्रों में उत्पन्न करना |
2. साहित्य के माध्यम से समाज एवं मानवीय मूल्यों को समझाकर, उन मूल्यों की रक्षा हेतु प्रेरित करना |
3. छात्रों में पुस्तक पठन एवं लेखन की अकृतिम प्रवृत्ति स्थापित करना |
4. अध्येताओं में साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास करना |

Course Outcomes:

अध्ययन की समाप्ति पर अध्येता –

CO1: सामाजिक मूल्य एवं नैतिक जवाबदेही को स्वीकार कर सकता है |

CO2: साहित्य की प्रासंगिकता को जीवन में समझने की दक्षता रखता है |

CO3: समाज में अंतर्निहित पद्धतियाँ एवं विचारधाराओं का व्याख्यान करने में सक्षम बन सकता है |

CO4: साहित्य के माध्यम से प्रभावी एवं कुशल संचार का विकास कर सकता है |

Course Pre-requisites:

- अध्येता, पी.यु.सी के स्तर पर द्वितीय भाषा के रूप में हिन्दी का अध्ययन करना चाहिए |
- हिन्दी साहित्य के इतिहास का संक्षिप्त ज्ञान की आवश्यकता है |
- हिन्दी व्याकरण का अवबोधन आवश्यक है |

अंग्रेज़ी – हिन्दी अनुवाद से संबंधित जानकारी जरुरी है |

Pedagogy: ICT and Digital support, Collaborative and Cooperative learning, Flipped Classroom

LTP: 2:1:0

Course type: CC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**इकाई - 1** उपन्यास ममता कालिया - दौड़ -	08Hrs.	CO1, CO2	PO5,08	POS1
Unit-2	**इकाई – 2** उपन्यास ममता कालिया - दौड़ -	08Hrs.	CO1, CO2	PO5,08	POS1
Unit-3	**इकाई -3** उपन्यास ममता कालिया - दौड़ -	07Hrs.	CO3, CO4	PO5,08	POS1
Unit-4	**इकाई - 4** **अ भाषाई कम्प्युटर** 1 यूनिकोड की वर्तमान स्थिति 2 हिन्दी में पावर पॉइंट का महत्व 3 हिन्दी में एम एस वर्ड, एक्सल शीट निर्माण विधि **आ ब्लॉग लेखन** 1 ब्लॉग लेखन का महत्व 2 हिन्दी मैं ब्लॉग लेखन की प्रविधि 3 इंटरनेट पर सामाग्री सृजन एवं यू ट्यूब पर प्रकाशन	07Hrs.	CO3, CO4	PO5,08	POS1

Reference Books:

1. उपन्यास - ममता कालिया - दौड़-
2. हिन्दी उपन्यास का विकास – मधुरेश
3. हिन्दी टंकण सिद्दांत – शिवनारायण चतुर्वेदी
4. हिन्दी साहित्य का इतिहास - डॉ. नागेन्द्र
5. आधुनिक हिन्दी साहित्य का इतिहास - डॉ. बच्चन सिंह
6. हिन्दी साहित्य का नवीन इतिहास - डॉ. लाल साहब सिंह
7. शुद्ध हिन्दी कैसे बोले कैसे लिखे- पृथ्वीनाथ पाण्डे
8. प्रयोजनमूलक हिन्दी – डॉ.अम्बादास देशमुख
9. कंप्यूटर के भाषिक अनुपयोग – विजयकुमार मलहोत्रा

Course Title: Additional English – IV

Course Code: B20BB4013

Course Description: This 2-credit course helps the learner explore various socio-cultural issues through literature. The course provides insight on matters like education and culture that are pertinent in the contemporary society. The course also offers multi-dimensional perspective in the genres of literature and contributes for language enrichment.

Course Objectives:

1. To infer the myths from the contemporary perspective.
2. To outline the idea of family represented in literature.
3. To interpret horror and suspense as a genre of literature.
4. To assess the impact of education in building a society

Course Outcomes:

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

CO1: Examine the relevance of myths and mythology.
CO2: Demonstrate family values and ethics essential to live in the society.
CO3: Analyze horror and suspense as a significant genre of literature.
CO4: Evaluate the applicability of academic contribution in building a society.

Prerequisites: The student must possess fair knowledge of language, literature, culture and society.

Pedagogy: Collaborative Method, Flipped Classroom, Blended Learning ICT and Direct Method

LTP: 2:1:0

Course type: CC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Myths & Mythology** John W. May – Narcissus W.B. Yeats – The Second Coming Devdutt Pattanaik - Shikhandi and the Other Stories They Don't Tell you (Extracts)	08Hrs.	CO1	PO5&8	POS1
Unit-2	**Family & Relationships** Nissim Ezekiel – Night of the Scorpion Langston Hughes – Mother to Son Kate Chopin – The Story of an Hour Henrik Ibsen – A Doll's House (Extract)	08Hrs.	CO2	PO5&8	POS1
Unit-3	**Horror & Suspense** Edgar Allan Poe – The Raven Bram Stoker – A Dream of Red Hands Satyajit Ray – Adventures of Feluda (Extract)	07Hrs.	CO3	PO5&8	POS1
Unit-4	**Education** The Dalai Lama – The Paradox of Our Times	07Hrs.	CO4	PO5&8	POS1

	Kamala Wijeratne – To a Student Sudha Murthy – In Sahyadri Hills, a Lesson in Humility Frigyes Karinthy – Refun				

Reference Books:

1. Finneran, Richard J. The Collected Works of W.B. Yeats (Volume I: The Poems: Revised Second Edition). Simon & Schuster, 1996.
2. Pattanaik, Devdutt. Shikhandi: Ánd Other 'Queer' Tales They Don't Tell You. Penguin Books, 2014.
3. Ezekiel, Nissim. Collected Poems (With A New Introduction By John Thieme). OUP, 2005.
4. Hughes, Langston. The Collected Poems of Langston Hughes. Vintage, 1995.
5. Chopin, Kate. The Awakening and Selected Stories of Kate Chopin. Simon & Schuster, 2004.
6. Ibsen, Henrik. A Doll's House. Maple Press, 2011.
7. Poe, Edgar Allan. The Complete Poetry of Edgar Allan Poe. Penguin USA, 2008.
8. Stoker, Bram. Dracula. Fingerprint Publishing, 2013.
9. Ray, Satyajit. The Complete Adventures of Feluda (Vol. 2). Penguin Books Ltd., 2015.
10. Lama, Dalai. Freedom In Exile: The Autobiography of the Dalai Lama of Tibet. Little, Brown Book Group, 1998.
11. Murthy, Sudha. Wise and Otherwise: A Salute to Life. Penguin India, 2006.

Course Title: New Venture Creation
Course Code: B20BB4020
Course Description: This soft-core course familiarizes the learners with aspects related to new venture planning and creating a new enterprise. It provides contents to the students to make them aware of the crucial aspects of industry and markets. The topics like creating formidable value proposition, identifying and mobilizing human capital for new business is discussed in this course. It familiarizes students with financial resources mobilization, allocation and managing in the process of new venture creation.
Course Objectives: 1. To familiarize the learners with aspects related to new venture planning. 2. To analyze the industry competitiveness for the new venture creation. 3. To create a formidable value proposition, identifying and mobilizing human capital and financial resources needed for new business.

Course Outcomes:

At the completion of the course the student shall be able to:
CO1: Identify lucrative business opportunities after analyzing the industry competitiveness adopting specific models.
CO2: Create the value proposition and branding for the new venture.
CO3: Appreciate and apply the methods and strategies for effective human resources management in the new venture.
CO4: Identify and allocate financial resources in a new venture effectively.

Course Pre-requisites: Basic knowledge of business organization and process of entrepreneurship.

Pedagogy: ICT, Discussions, Flip classrooms, case studies, business games, collaborative methods. Direct Method

LTP: 2:1:0

Course type: Soft Core

Contact Hours: 39 Hours

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to New ventures:** Opportunity identification, the search for new ideas, Source of innovative ideas, Techniques for generating ideas, Entrepreneurial imagination and creativity thinking. Methods to Initiate Ventures: The pathways to New Ventures for Entrepreneurs, Creating New Ventures, acquiring an established Venture: Advantages of acquiring an ongoing Venture, Examination of key issues, Franchising: How a Franchise works. Franchise Law. Evaluating the franchising opportunities. Getting Sensitized with industry and market: Defining the market and industry; concentration and geographic spread: Estimating market size; SWOT analysis- Screening and selecting appropriate option.	9 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Developing value proposition for the new venture:** Value proposition and branding: Identifying target customers-Defining value proposition-Differentiation through branding Sustainable entrepreneurship, Developing Mission statement. IPR- Patents, copyrights, trademarks, Legal acts governing businesses in India. Identifying Form of	10 Hrs.	CO2	PO2 & PO3	POS1

	Organisation: Sole Proprietorship, Partnership, Limited Liability Partnership and Company, Highlights of Companies Act.				
Unit-3	**Managing and leading people:** Attracting the right people- Team building; Organizational structure, design and control; Shaping Culture- Leadership and management - Entrepreneurial leadership	10 Hrs.	CO3	PO2 & PO3	POS1
Unit-4	**Financial Resources and marketing strategies for new venture:** Studying and comparing different sources (e.g. banks, venture capital, angel investors, private equity, crowd-funding, etc.) of finance; Selecting the right source of finance. Preparing and using financial forecasts: Forecast sales turnover, income statement and costs - Forecast breakeven point SMART Performance metrics; Valuing the business. Developing a Marketing Plan: Customer Analysis, sales Analysis and Competition Analysis, Market Research, Sales Forecasting, evaluation, Pricing Decision. Business Plan Preparation for New Venture: Business Plan: Concept, Pitfalls to avoid in Business Plan, Benefits of a Business Plan.	10 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. Bruce R. Barringer, R. Duane Ireland. (2019). Entrepreneurship: Successfully Launching New Ventures Pearson, Latest edition.
2. Tom Rath. Strengths Finders 2.0, Gallup Hisrich, Peters, & Shepherd, 2017.
3. Irwin, Entrepreneurship, McGraw Hill, 10th Edition, Boston, MA: (ISBN 978-0-07-811284-3)
4. Spinelli, & Adams. 2016. New Venture Creation: Entrepreneurship for the 21st Century. 10th Edition, Boston, MA: Irwin McGraw-Hill.
5. Timmons, Zacharakis, & Spinelli, 2004. Business Plans that Work: A Guide for Small Business, New York, NY: McGraw-Hill.
6. David H. Holt Entrepreneurship: New Venture Creation Pearson, Latest edition

Course Title: Business Law
Course Code: B20BB4030
Course Description: This course introduces the legal context in which business is conducted in common law and civil law jurisdictions. Emphasis is placed on Contracts Law, followed by an introductory look at business-related topics including Corporations and other forms of business organization.

Course Objectives:

1. To introduce the students to various regulations affecting business and
2. To familiarize the students with such regulations.
3. To Explore on the environmental protection acts and its importance in managing business activities ethically.
4. To understand the consumer laws under the sale of goods and regulations to overcome the conflicts.

Course Outcomes:

By the end of the course, the student shall be able to ….

1. Understand the various laws existed and explore more on contractual laws and its framework.
2. Gain enough knowledge on contractual agreements under patents and its procedures.
3. Explore on the environmental protection acts and its importance in managing business activities ethically.
4. Understand the consumer laws under the sale of goods and regulations to overcome the conflicts.

Course Pre-requisites: Basics of Law

Pedagogy:Direct Method and ICT

LTP: 3:1:0

Course type: HC

Contact Hours: 52

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Business Laws** Introduction - Nature of Law - Meaning and Definition of Business Laws - Scope and Sources of Business Law - Fundamental Rights and Directive Principle of State Policies - Principles having economic significance - Overview of Business Laws in India.	13 Hrs.	CO1	PO6	POS1
Unit-2	**contract laws -Indian contract ACT, 1872**: Definition of Contract - essentials of a valid contract (all essentials need to be explained in great detail) - classification of contracts - breach of contract and remedies for breach of contract. **Indian Sale of Goods Act, 1930**: Definition of contract of sale - essentials of contract of sale-conditions and warrantees - rights and duties of buyer - rights of an unpaid seller.	13 Hrs.	CO2	PO6	POS1
Unit-3	**information laws and environment protection ACT, 1986 -Right to Information Act, 2005**:	13 Hrs.	CO3	PO6	POS1

	Objectives of the RTI Act – Scope - Method of seeking information - Eligibility to obtain information - Authorities under the Act. **Environment Protection Act, 1986**: Objects of the Act - definitions of important terms – environment, environment pollutant, environment pollution, hazardous substance and occupier - types of pollution - global warming - causes for ozone layer depletion – carbon trade - rules and powers of central government to protect environment in India.				
Unit-4	**Competition and Consumer Laws: The Competition Act, 2002**: Objectives of Competition Act - the features of Competition Act - components of Competition Act - CCI, CAT, offences and penalties under the Act. **Consumer Protection Act, 1986**: Definition of the term's consumer - consumer dispute, defect, deficiency, unfair trade practices and services. -Consumer Protection Act - Consumer Redressal Agencies – District Forum - State Commission - National Commission - any two landmark judgments of the Supreme Court.	13 Hrs.	CO4	PO6	POS1

Reference Books:

1. Principles of Mercantile Law, Avtar, S. (2011). (10th Edition), Eastern Book Company, New Delhi.
2. Elements of Mercantile Law, Kapoor, N.D (2012.)., Sultan Chand & Sons, NewDelhi.
3. Business laws, Chopra, K.C.,, 2011, 5th Edition – HPH PUBLICATION
4. Corporate Laws, Taxmann Publications Vol II: 2019, 39
5. Law of Sale of Goods, Singh Avatar, 2019, 8 – Eastern Book Company
6. Law Relating to Intellectual Property Rights, Ahuja, V K ,: 2019, 3 – Lexis Nexis
7. Law Relating to Intellectual Property Rights, Bhandari, M K , , 2019, 5 – Central Law Publications

Course Title: Production and Operation Management
Course Code: B20BB4040
Course Description: This course reviews the management of operations in manufacturing, service, and government organizations. Topics include a review of the activities and responsibilities of operations management, the tools and techniques available to assist in running the operation, and the factors considered in the design of the system.

Course Objectives:

The objective of this course is to enable students to:

1. Obtain the adequate knowledge regarding the basic manufacturing facilities
2. Understand the service activities that have attained significance and need of managerial skills to address the problems.
3. Understand how to manage resources to achieve superior quality through statistical process control and using the methods involved in forecasting demand
4. To provide with insights on material management concepts applied in the business

Course Outcomes:

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

CO1: Conduct Facility planning by making location and layout decisions.
CO2: Plan and implement suitable materials handling principles and practices in the operations.
CO3: Analyze and develop a balanced line of production & scheduling and sequencing techniques in operation environments.
CO4: Demonstrate an understanding of production as a process of converting or transforming resources into products;

Course Pre-requisites:

This course requires knowledge of basic mathematics and managerial economics

Pedagogy: Direct Mrthod and ICT

LTP: 3:0:1

Course type: HC

Contact Hours: 52

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Production & Operations Management**: Definition of Production and Operations. An overview of Manufacturing processes, Historical Evolution of Production and Operations Management, Concept of Production, Production System, Classification of Production System, Objectives of Production Management, Objectives of Operations Management, Managing Functions of Production, Planning & Control. Interface of Product Life Cycle & Process Life Cycle. Process design – Project, Job, Batch, Assembly and Continuous process.	12 Hrs.	CO1	PO7	POS1
Unit-2	**Plant Management and Work Study**: Capacity Planning, factory location, plant layout – types of layout. Sequencing of Jobs: n-Jobs with one, two and three facilities. Maintenance Management: Repair Programme, Break down, Preventive and Corrective maintenance. Productivity and Work Study: The concept and various techniques of methods analysis and work measurement	12 Hrs.	CO2	PO7	POS1
Unit-3	**Quality Control, Demand Forecasting Q**uality Control: Introduction, Quality, Fundamental Factors Affecting Quality, Need for	14 Hrs.	CO3	PO7	POS1

	Controlling Quality Inspection, Types of Quality Control, Steps in Quality Control, Objectives of Quality Control, Benefits of Quality Control, Seven old and new Tools for Quality Control, Causes of Variation in Quality, Statistical Process Control Introduction. Methods of Demand Forecasting, Theory and Problems of Demand Forecasting				
Unit-4	**Material Handling and Materials Management:** Introduction and Meaning, Objectives of Material Handling, Principles of Material Handling, Selection of Material Handling Equipment's, Evaluation of Material Handling System, Guidelines for Effective Utilization of Material Handling Equipment. Materials Management: Introduction and Meaning, Scope or Functions of Materials Management, Material Planning and Control, Purchasing, Stores Management, Inventory Control or Management, Standardization, Simplification, Just-In-Time (JIT) Manufacturing, Six Sigma concept	14 Hrs.	CO4	PO7	POS1

Reference Books:

S.N. Chary, "Production & Operation Management" 5th Edition, Tata-McGraw – Hill Publishing Company Ltd.

2. N.G. Nair, "Production and Operation Management", 2nd Edition, Tata-McGraw – Hill Publishing Company Ltd.

3. Kanishka Bedi, "Production and Operations Management", 2007, 3rd Edition, Oxford University Press.

4. S. Anil Kumar and N Suresh, (2015) *Production and Operations Management*, New Age International publishers.

5. K. Aswathappa, G. Sudarsana Reddy, M Krishna Reddy, (2013) *Production and Operations Management*, Himalaya Publishers.

6. Gaither, N & Frazier, (2002) *Production & Operations Management*, Thomson Learning Publications

Course Title: International Business
Course Code: B20BB4050
Course Description: An understanding of international business is essential for students in today's interdependent global world. This course will provide students with the knowledge, skills, and abilities to understand the global economic, political, cultural and social environment within which firms operate.

Course Objectives:

1. The objective of this subject is to facilitate the students in understanding International Business in a multicultural world.
2. To understand cross-border -Input-procurement, such as raw materials, finance, technology, and human resources.
3. To understand the effective modes of Entry into International Business

Course Outcomes:

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

CO1: Understand most widely used international business term and concepts
CO2: To develop an entry strategy into other market recognizing the nature of institutions and forces governing the process of globalization.
CO3: Analyze the principle of international business and strategies adopted by firms to expand Globally
CO4: To understand the sources and procedures of International Marketing and Export trade.

Course Pre-requisites: Business Management

Pedagogy: ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours: 39 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to International Business:** Meaning and Definition– nature and characteristics of International Business-stages- International Business Environment Theories of International Trade- Advantages &Disadvantages. Approaches to international business	10 Hrs.	CO1	PO4	POS1
Unit-2	**Modes of Entry into International Business** Mode of Entry – Exporting – Licensing – Franchising – Contract Manufacturing – Turn Key Projects –Foreign Direct Investment – Mergers, Acquisitions and Joint Ventures – Comparison of different modes of Entry.	9 Hrs.	CO2	PO4	POS1
Unit-3	**Globalization and MNC: Globalization**: Meaning - Features – Stages –Production –Investment and Technology, Globalization –Advantages and Disadvantages – Methods and Essential Conditions for Globalization. **MNC's and International Business**: Definitions – Distinction between Indian Companies – MNC – Global companies and TNC – Organizational Transformations – Merits and Demerits of MNCs in India	10 Hrs.	CO3	PO4	POS1
Unit-4	**International Marketing Intelligence and Exim Trade:** Information required – Source of	10 Hrs.	CO4	PO4	POS1

	Information – International Marketing Information System and Marketing Research. Export Trade - Procedure, Steps & Documentation– Export Financing –Documents related to Export Trade – Import Trade –Steps - Documentations and Problems - Balance of Payment – Disequilibrium and Measures for Rectification				

Reference Books:

1. International Business Text and Cases-2nd Revised and enlarged, P Subba Rao 2016
2. International Business – Environment and management-12th revised and enlarged edition (2017) Anmol Publications Private Ltd. New Delhi 110002 (India)
3. International Business – Competing in the Global Marketplace-6th Edition, The Tata McGraw Hill publishing Company Ltd.-Charles W L Hill,
4.International Business Environments and Operations-11th Edition, John D Daniels-2017

Course Code	Course Title	Course Type	L	T	P	C	Hrs./ Wk.
B20BB4060	**Skill Development Course**	**RULO**	**0**	**0**	**0**	**0**	**4**

I-FINANCE SPECIALIZATION

Course Title: Corporate Financial Policy
Course Code: B20BB4111
Course Description: The course will focus on corporate finance from the managerial point of view. The course is intended to enable the students to understand the logic underlying these concepts and theories of corporate finance. The course will emphasize on the real-life applications of the concepts. In order to achieve this goal.The course in all introduces the students to various aspects of corporate financial decision.
Course Objectives: 1. Familiarize the corporate financial policies. 2. To familiarize the students with Investment aspects 3. Acquaint the students with the types of corporate valuation and cost of capital 4. Impart the students with the types of business combinations with exchange ratio.
Course Outcomes: After the completion of the course, students will be able to: CO1: Describe corporate financial Policies and Calculate the EPS. CO2. Understand the types of risks that come across in the business activities CO3. Illustrate the corporate valuation and cost of capital and their different approaches. CO4. Understand different types of combination and their impact.
Course Pre-requisites: Basic Financial Management concepts
Pedagogy: Case Studies, Group Discussions, ICT and Direct Method

LTP: 2:1:0					
Course type: SC					
Contact Hours:39					
Units	**Detailed Syllabus**	**CH**	**CO**	**PO**	**PSO**
Unit-1	**Financial Policy:** Meaning – Scope - Interface of Corporate Financial Policy and other Managerial Functions – Decision in Corporate Financing Policy – Debt Financing – Internal Financing - Factors to be considered in formulating Financing Policy – Problems on EPS and Point of Indifference.	9 Hrs.	CO1	PO2	POS1
Unit-2	**Investment Decisions and Risk Analysis:** Risk Analysis – Types of Risks – Risk and Uncertainty – Techniques of Measuring Risks – Risk adjusted Discount Rate Approach – Certainty Equivalent Approach – Sensitivity Analysis - Probability Approach - Standard Deviation and Co-efficient of Variation – Decision Tree Analysis – Problems.	10 Hrs.	CO2	PO2	POS1
Unit-3	**Corporate Valuation:** Meaning of Corporate Valuation – Methods of Corporate Valuation – Reasons for Corporate Valuation – Different approaches for Corporate Valuation **Cost of Capital:** Meaning and Definition – Significance of Cost of Capital – Types of Capital – Computation of Cost of Capital – Specific Cost – Cost of Debt – Cost of Preference Share Capital – Cost of Equity Share Capital – Weighted Average Cost of Capital – Problems	10 Hrs.	CO3	PO2	POS1
Unit-4	**Mergers and Acquisitions** Meaning - Reasons – Types of Combinations - Forms of Merger – Motives and Benefits of Merger –Financial Evaluation of a Merger - Merger Negotiations - Meaning and Significance of P/E Ratio. Problems on Exchange Ratio and Impact of Merger on EPS and Market Price.	10 Hrs.	CO4	PO2	POS1

Reference Books:

1. Prasanna Chandra, Financial Management, 10th Edition, Tata McGraw Hill,2019.
2. Chandra, Projects: planning, Analysis, Financing implementation and review, TMH,9/e New Delhi,2019.
3. Bodie, Kane, Marcus: Investment, Tata McGraw Hill, 11/e, New Delhi 2019.
4. I. M. Pandey, Financial Management, Vikas Publishing House, 11th edition,2016.
5. M. Y. Khan and P. K. Jain, Financial Management Text and Problems, Tata McGraw Hill Publishing Co,8/e, 2018.

6. Entrepreneurship, Rajeev Roy, Oxford Higher Education, 2/e, 2011

Course Title: International Finance

Course Code: B20BB4112

Course Description: The business these days are operational in interconnected global markets. This course provides students an overview about international financial market and its growth. The course introduces the student to the international monetary system. Also, one is introduced to the operations that happens in international business transactions.

Course Objectives:

1. To enable the students to understand the actual concept of International Financial System.
2. To enable the students to gain knowledge regarding international Monetary system
3. To Provide students with a basic knowledge of how international financial markets work.
4. To Provide students with an understanding of exchange rates and why currency values fluctuate.

Course Outcomes:

CO1: To enable the students to understand the basic structure of international financial market
CO2. To enable the students to basics of foreign exchange market
CO3. To enable the students to understand the international monetary system
CO4. To enable the students to analyze the risks of investing in international market

Course Pre-requisites: Knowledge of basic foreign exchange market, International financial system

Pedagogy: Case Studies, Group Discussions, ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**International Finance:** Introduction - Meaning of International Finance – Components of international finance– Modes of international business- Foreign Exchange Markets. Meaning of International Financial Management - Scope and significance of International financial management in International markets, Top traded foreign currencies, Leading stock exchanges in the world, Basics of Foreign Exchange transactions, Spot, Forwards and Futures.	10 Hrs.	CO1	PO2	POS1
Unit-2	**International Flow of Funds and International Monetary System: - International Flow of Funds**: Balance of Payments (BOP), Fundamentals of BOP, Accounting components of BOP, Factors affecting International Trade and capital flows, Agencies that facilitate International flows. BOP, Equilibrium & Disequilibrium. Trade deficits. **International Monetary System:** Evolution, Gold Standard, Bretton Woods system, the flexible	11 Hrs.	CO2	PO2	POS1

	exchange rate regime, the current exchange rate arrangements, the Economic and Monetary Union (EMU). International Financial Institutions: WB, BIS, IBRD, ADB, Regional Financial Institutions,				
Unit-3	**International Financial Markets and Instruments:** Foreign Institutional Investors – Regulations governing Foreign Institutional Investors India; International Bond & Equity market. GDR, ADR, Cross listing of shares Global registered shares. International Financial Instruments: Foreign Bonds & Eurobonds, Global Bonds. Foreign Direct Investment (FDI) – growth FDI; Advantages and Disadvantages of FDI to Host country and home country. Trends in FDI in India International Banking services –Correspondent Bank, Representative offices, Foreign Branches. Evolution of International financial system4	10 Hrs.	CO3	PO2	POS1
Unit-4	**International Risk Management**: Types of Risk – Political – commercial - exchange control restrictions and remittance differing tax system - sources of funds - exchange rate fluctuations - different stages and rates of inflation - risks of non-payment - Managing Risk - Internal and external technologies. International capital budgeting	08 Hrs.	CO4	PO2	POS1

Reference Books:

1. **V A Avadhani, International Financial Management, 2016**
2. Vyupthakesh Sharan, International Financial Management –, 6/e, PHI, 2010.
3. International Financial Management – Apte P. G, 7/e, TMH, 2017.
4. International Financial Management – Jain, Peyrard & Yadav, Macmillan 2010
5. International Financial Management- S Kevin, PHI, 2009

II-HUMAN RESOURCE SPECIALIZATION

Course Title: Strategic Human Resource Management
Course Code: B20BB4211
Course Description: Human resource student is best prepared for a career in HR when HR is taught within the business context. The competitive nature of today's global marketplace and its increasing strategic nature of the profession demand a higher level of readiness. To become an HR professional, one must be very well prepared. A critical first step is earning a well-rounded, robust undergraduate degree, with specialization in human resource subject.

Course Objectives:

1. To familiarize the students with the concepts of SHRM
2. To acquaint the students with difference between HRM and SHRM
3.To familiarize the students with the various HR processes and systems.
4.To familiarize the students with the basic concepts of Labor Laws

Course Outcomes:

CO1: Comprehend the different aspects of managing people in the organization.
CO2: Understand the various functions of a HR Manager.
CO3: Analyze the importance of HR functions in an organization.
CO4: Illustrate the various HR systems and processes

Course Pre-requisites: Basic knowledge of HRM subject

Pedagogy: Flip classes, case studies, anecdotes, ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours:39Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction HRM and Acquisition Of Human Resource** Human Resource Management: Concept and Functions, Role, Status and competencies of HR Manager, HR Policies, Evolution of HRM, HRM vs HRD. Human Resource Planning: Quantitative and Qualitative dimensions; job analysis – job description and job specification; Recruitment – Concept and sources; Selection – Concept and process; test and interview; placement and induction.	9 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Training and Development:** Concept and Importance: Identifying Training and Development Needs; Designing Training Programmes; Role-Specific and Competency-Based Training; Evaluating Training effectiveness; Training Process Outsourcing; Management Development	10 Hrs.	CO2	PO2 & PO3	POS1
Unit-3	**Performance Appraisal:** Performance Appraisal: Nature, objectives and importance; Modern techniques of performance appraisal; potential appraisal and employee counseling; job changes - transfers and promotions	10 Hrs.	CO3	PO2 & PO3	POS1
Unit-4	**Industrial Relations:** Industrial Relations: Introduction to Industrial Relations, Trade Union: Trade unions role, types, functions, problems, industrial dispute- concept, causes & machinery for settlement of disputes-grievance, concepts, causes & grievance redressal machinery, discipline concept, aspect of discipline & disciplinary procedure	10 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. V S P Rao, "Human Resource Management- text & cases" (3rd Edition) EXCEL BOOKS
2. Gary Dessler. A Framework for Human Resource Management. (7th Edition) Pearson Education.
3. Strategic Human Resource Management: An Indian Perspective (2006 Edition) Sage Publications
4. Robert L. Mathis and John H. Jackson. Human Resource Management. Cengage Learning.
5. TN Chhabra, Human Resource Management, Dhanpat Rai & Co., Delhi
6. Biswajeet Patttanayak, Human Resource Management, PHI Learning

Course Title: Compensation Management

Course Code: B20BB4212

Course Description: This course is designed to provide the student with knowledge of methods and practices of Compensation Management. It enables students to understand and perform job positions of different fields. It also serves to develop and strengthen overall analytical skills of students Related to various HR Functions.

Course Objectives:

1. Illustrate the concepts and implications of role of Compensation Management in Business.
2. To make the students acquaint with the remuneration system.
3. To learn the concepts of payments and employee benefits.

Course Outcomes:

After the completion of the course, students will be able to:
CO1: To learn basic compensation concepts and the context of compensation practice.
CO2: To understand the different ways to strengthen the pay-for-performance link.
CO3: To understand the various pay structure.
CO4: To understand the Legally required employee benefits.

Course Pre-requisites: Knowledge about Management and HRM

Pedagogy: Direct Method, ICT, Flipped classroom and case study discussions

LTP: 2:1:0

Course type: SC

Contact Hours:39 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction:** Compensation: Concept, factors, Base and Supplementary Compensation, Wage and Salary, Wage Components: minimum wage, Fair wage, living wage, Wage Policy in India, Wage differentials, Wage Theories: Market Theories, Human Capital Theories, Bargaining Theories – Social Theories, Economic and Behavioral theories. A relevant Case study should be discussed in class.	10 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Job Evaluation:** Job Evaluation: nature and importance- methods, Computer aided job	9 Hrs.	CO2	PO2 &	POS1

	evaluation, Internal and external equity- Pay surveys. Compensation management in public, private and emerging sectors. A relevant Case study should be discussed in class.			PO3	
Unit-3	**Pay Structure:** Pay structure: Types, Broad Banding, Performance Linked Compensation - Types of Incentives: Bonus, Profit sharing, Gain Sharing, stock options, Benefits and allowances-types, Executive and shop floor level rewards, Compensating Expatriates and knowledge workers. A relevant Case study should be discussed in class.	10 Hrs.	CO3	PO2 & PO3	POS1
Unit-4	**Wage Administration:** Legal Framework**:** Legal framework of Wage Determination Welfare Legislations, Tax Planning, Downsizing, VRS, gratuity, commutation, pension plans, Machinery for wage fixation: Wage Boards – Pay Commissions –Statutory Wage Fixation. Emerging Issues: Compensation Management-Future trends. A recent case study should be discussed in class.	10 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. Bhattacharya, Compensation Management, (2014 Edition) Oxford Press
2. Michael A. Armstrong and Helen Murlis, Reward Management: A Handbook of Remuneration Strategy and Practice, (2nd Edition) London Kogan Page.
3. B D Singh, Compensation and Reward Management Excel Books. New Delhi.
4. Milkowich, Newman, Compensation, Tata McGraw Hill, New Delhi.

III-MARKETING SPECIALIZATION

Course Title: Retail Management
Course Code: B20BB4311
Course Description: This course provides the student with a comprehensive view of retailing, an analysis of the retail environment and exposure to issues and challenges in designing retail mix strategies.
Course Objectives: 1. To provide the knowledge of basic concepts of retail management. 2. To understand the various dimensions related to retail management &retail operations. 3. To gain knowledge about the retail marketing mix and various decision parameters related to retail mix. 4. To understand the use of various IT tools in retail business.

Course Outcomes:
After the completion of the course, students will be able to:
CO1: Explain the concept, importance and functions of retail business.
CO2: Elaborate and analyze the concepts of retail operations.
CO3: Explain the retail marketing mix and decisions related to these elements.
CO4: Elaborate on the various ways IT has impacted retail

Course Pre-requisites: Basics of Marketing

Pedagogy: Lecture, guest lectures, seminars, conferences, independent works, ICT and Direct Method**, presentations, discussions**

LTP: 2:1:0

Course type: SC

Contact Hours:39 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to retailing:** Definition – functions of retailing - types of retailing – forms of retailing based on ownership - Retail theories – Wheel of Retailing – Retail life cycle - Retailing in India – Influencing factors – present Indian retail scenario - Retailing from the International perspective	9 Hrs.	CO1	PO6	POS1
Unit-2	**Retail operations:** Choice of Store location – Type of Location, Influencing Factors, Market area analysis – Trade area analysis – Rating Plan method - Site evaluation - Retail Operations - Store Layout: Store designing – Space planning, and visual merchandising –Meaning &Role, Tools & Technique of visual merchandising, Merchandise Management: Process, Inventory management – Category Management.	10 Hrs.	CO2	PO6	POS1
Unit-3	**Retail Marketing Mix:** Retail marketing mix – Introduction. **Product** – (Merchandise Management revisited) –Decisions related to delivery of service. **Pricing** – Influencing factors – approaches to pricing – price sensitivity - Value pricing – Markdown pricing. **Place** – Supply channel – SCM principles – Retail logistics – computerized replenishment system – corporate replenishment policies. **Promotion** – Setting objectives – communication effects - promotional mix.	10 Hrs.	CO3	PO6	POS1
Unit-4	**Impact of It in Retailing:** Non store retailing (E tailing), The impact of Information Technology in retailing - Integrated systems and networking – EDI – Bar coding – Electronic article surveillance – Electronic shelf labels – customer database management system - Legal aspects in retailing -	10 Hrs.	CO4	PO6	POS1

	Social issues in retailing - Ethical issues in retailing. Introduction to Retail Research and shopping mall management. Cases in Indian Context on Retail Management.				

Reference Books:

1. Barry Bermans and Joel Evans, "Retail Management – A Strategic Approach", 9th edition, PHI Private Limited, New Delhi, 2013.
2. Swapna Pradhan, Retailing Management, 3/e, 2011 Tata McGraw-Hill Education
3. A.J. Lamba, "The Art of Retailing", 2/e edition, Tata Mc GrawHill, New Delhi, 2003.
4. Suja Nair: Retail Management, 2011, Himalaya Publishing House.
5. Rosemary Varley, Mohammed Rafiq, Retail Management, 2/e, 2006 Palgrave Macmillan
6. Siva Kumar; Retail Marketing, Excel Books.
7. James R. Ogden & Denise T. Ogden, Integrated Retail Management 2007, Biztantra Cengage Learning
8.Levy &Weitz, Retail Management, TMH 6th Edition 2009

Course Title: Consumer Behavior

Course Code: B20BB4312

Course Description: The course outlines the ideas of consumer behavior involving concepts such as perception, motivation, attitude formation and change, personality, values, learning, and cultural aspects that influence the consumer behavior decision-making process.

Course Objectives:

1. To provide knowledge of basic concepts of Consumer Behavior to apply in market.
2. To understand the various Individual and group determinants of Consumer Behavior.
3. To gain knowledge about the consumer decision making process and theories involved in consumer decision process.
4. To understand the concept of Consumer satisfaction & consumerism.

Course Outcomes:

After the completion of the course, students will be able to:
CO1 Explain the concept and importance of consumer behavior in day-to-day functions.
CO2: Identify the factors influencing consumer buying process and its application.
CO3: Determine the factors influencing consumer behavior
CO4: Discuss the concept of consumerism in today's competitive world.

Course Pre-requisites: Basics of Marketing

Pedagogy: Lecture with ICT tool, guest lectures, seminars, Direct Method**, presentations, discussions**

LTP: 2:1:0

Course type: SC

Contact Hours:39 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Consumer Behaviour :** Introduction to Consumer Behavior: Meaning,	9 Hrs.	CO1	PO6	POS1

	need to study Consumer Behavior - Applications of consumer behavior knowledge - current trends in Consumer Behavior, Internal and external factors affecting CB				
Unit-2	**Individual and Environmental Determinants** Consumer needs & motivation - personality and self-concept - consumer perception - learning & memory - nature of consumer attitudes - consumer attitude formation and change. Family influences - Influence of culture - subculture & cross-cultural influences - group dynamics and consumer reference groups - social class & consumer behavior.	10 Hrs.	CO2	PO6	POS1
Unit-3	**Consumer's Decision-Making Process :** Problem recognition - Search & Evaluation - Purchase processes - Post-purchase behavior - personal influence& opinion leadership process - Diffusion of innovations - Models of Consumer Behavior - Researching Consumer behavior - Consumer research process.	10 Hrs.	CO3	PO6	POS1
Unit-4	**Consumer Satisfaction & Consumerism :** Concept of Consumer Satisfaction - Working towards enhancing consumer satisfaction - sources of consumer dissatisfaction - dealing with consumer complaint. Concept of consumerism - consumerism in India - The Indian consumer - Reasons for growth of consumerism in India. Cases in Indian Context on Consumer behaviour.	10 Hrs.	CO4	PO6	POS1

Reference Books:

1. Leon. G. Schiffman &LeslveLazerKanuk; Consumer behaviour; 7th Edition; PHI, New Delhi, 2010.
2. Suja. R. Nair, Consumer behaviour in Indian perspective, First Edition, Himalaya Publishing House, Mumbai, 2009.
3. Batra/Kazmi; Consumer Behaviour. 2/e, Excel Books, 2008
4. David. L. Loudon & Albert J. Bitta; Consumer Behaviour; 5th Edition, Mcgraw Hill, Inc; New Delhi, 2008.
5. Assael Henry; Consumer behaviour and marketing action; Asian Books(P) Ltd, Thomson learning, 6th Edition; 2001.
6. S.A.Chunawalla : Commentary on Consumer Behaviour, 2/e, HPH.
7. Jay D. Lindquist & M. Joseph Sirgy, Shopper, Buyer and Consumer Behaviour, 2003.
8. Blackwell; Consumer Behaviour, 2nd Edition.

IV. Specialization – International Business

Course Title: International Trade And Policy Framework

Course Code: B20BB4411

Course Description: This course concentrate olicy incentives help exporters increase their profitability through foreign sales. Trade policy refers to the complete framework of laws, regulations, international agreements, and negotiating stances adopted by a government to achieve legally binding market access for domestic firms.

Course Objectives:

1. To acquainting the students with the theoretical foundations of international trade
2. To enabling them to learn the pattern, structure and policy framework of India's foreign trade.

Course Outcomes:

1.To discuss about Theoretical Foundations of International Trade and direct investment.
2.Describe Instruments of Commercial Policy and Factor Movements and International Trade in Services
3.Analyze the Regional Economic Integration
4.Eloborate Policy Framework and Promotional Measures

Course Pre-requisites: Service Sector Management

Pedagogy: ICT. Flipped classes

LTP: 2:1:0 -3

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Theoretical Foundations of International Trade:** Reasons for international trade: Mercantilist and neo-mercantilist view; Theories of international trade: Absolute and comparative advantage theories: Modern theories of trade; Gains from trade; Foreign trade multiplier; Terms of trade. **Direct Investment:** FDI in the world economy, The Political Economy of FDI, Cost and Benefit of FDI to Host and Home Countries, Government Policy Instruments and FDI; Foreign debt situation.	9	1	3,4	2
Unit-2	**Instruments of Commercial Policy:** Tariffs quotas and other measures and their effects; Arguments for and against protection; Trade regulations and WTO; Trade policy and developing countries. **Factor Movements and International Trade in Services:** Capital Flows-Types and theories of foreign investments, Barriers to foreign investments; Labour migration; Theory of international trade in services.	10	2	3,5	1
Unit-3	**Regional Economic Integration:** Levels of Regional Economic Integration; Free trade area, customs union, economic union, and common market; Trade creation and diversion effects, NAFTA, EU, SAARC, ASEAN.	10	2	4,5	2
Unit-4	**Policy Framework and Promotional Measures:** India's foreign trade and investment policy; Policy making body	10	2	4,5	3

	and mechanism; Export promotion measures and infrastructure support – export and trading, houses, export promotion schemes and incentives; Institutional arrangements for export promotion; Export processing/special economic zones, 100% EOUs				

Reference Books:

1. Economic Survey, Govt. of India.
2. Export-import Policy and Other Documents, Govt. of India.
3. Hazari, R. Bharat, Micro Economic Foundations of International Trade, Croom Helm, London and Sydney.
4. Letiche, John M., International Economics: Policies and Theoretical Foundations, Academic Press, New York.
5. Mannur, H.G., International Economics,Vikas Publishing House, New Delhi,
6. Sodersten, BO, International Economics, McMillan, London

Course Title : Foreign Exchange Management

Course Code: B20BB4412

Course Description: This course concentrate in changing of the forex market scenario, how the foreign exchange market operates and techniques that can be used to reduce the risk. This program will help the students to gain a comprehensive knowledge regarding the foreign exchange management.

Course Objectives:

1. To understand the system of Foreign Exchange Market in India

2. To understand the Forex risk and its Management

Course Outcomes:

CO1: Determine the foreign exchange market in India

CO2: Understand about the Foreign exchange rates & risk involved in Forex market

CO3: Impart the knowledge on how to manage & hedge the risk associated with foreign trade

CO4: Enumerate the concept of Exchange rate management

Course Pre-requisites: Basic Concepts of Import & export

Pedagogy: ICT & FLIPPED CLASSROOM

LTP:2:1:0=3

Course type: SC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
UNIT-1	**Foreign Exchange And Markets** Introduction – Meaning – Elements – Importance – Evolution of Exchange Rate System – International Monetary System – Gold Standard – types of exchange rates – Fluctuations in Foreign Exchange rates – Causes and Effects – Need for Stable foreign exchange Rates – Determination of Exchange rates – Theories of Determination of Foreign Exchange Rates.	**9**	**1**	1,2	1

UNIT-2	**Forex Market In India** Introduction – Meaning – Types – Operations – Convertibility - Objectives of Foreign Exchange Control – Problems of Foreign Exchange market in India – Mechanism to settle the problems - Role of RBI in settlement of foreign exchange problems in India.	**10**	**2**	2,3	2
UNIT-3	**Forex Risk Management** Meaning, Definition, Participants, Types of Exchange risks, Foreign Exchange Risk Management – Hedging, Speculation and Management of Transaction Exposure – Using Forward Markets for Hedging – Hedging with Money Market - Currency Options and Currency Futures – Internal Strategies – Speculation in Foreign Exchange and Money Market.	**10**	**3**	4,5	3
UNIT-4	**Exchange Rate Management** Exchange Rate Determination and Forecasting – Setting the Equilibrium Spot Exchange Rate – Theories of Exchange Rate Determination – Exchange Rate Forecasting. Management of Interest Rate Exposure – Nature and Measurement – Forward Rate Agreements (FRA's) Interest Rate Options – Caps - Floors and Collars - Cap and Floors – Options on Interest Rate Futures - Some Recent Innovations – Financial Swaps.	**10**	**4**	4,6	3

Reference Books

1. Chaudhuri & Agarwal: Foreign Trade and Foreign Exchange, HPH
2. Mcrae T.N and D.P Walkar, Foreign Exchange Management, Prentice Hall.
3. Avadhani B.K, International Finance Theory and Practice.
4. Somanatha: International Financial Management I.K. International Publishers

FIFTH SEMESTER

Course Title: Income Tax
Course Code: B20BB5010
Course Description: This course is introductory level of income tax for Under graduate students. It is mandatory for all the students to have knowledge about this subject. It also provides platform for students to prepare for other professional certified courses. Under this course students will learn the basic concept of taxation as well as also able to learn the filing of e- return.
Course Objectives: 1. To develop an understanding of the provisions, concepts of Income tax 2. To acquire the ability to interpret and analyze the provisions of Income Tax 3. To develop an understanding of filing an e- returns and form 16

Course Outcomes:
After the completion of the course, students will be able to:
CO1: Recap the basic concepts of Income Tax, and determine the residential status of an assesse.
CO2: Compute the value of taxable allowances, perquisites and overall tax liability under salary head.
CO3: Compute the income chargeable under the head of income from house property.
CO4: Compute the total income liability of an individual.

Course Pre-requisites: Students should be aware of the word Income Tax

Pedagogy: ICT, Flipped class room, Direct Method

LTP: 3:0:1

Course type: Hard core

Contact Hours:52 hrs

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Brief History** - Legal Frame Work – Types of Taxes - Cannons of Taxation –Important Definitions: Assessment – Assessment Year – Previous Year – Exceptions to the general rule of Previous Year - Assessee – Person – Income - Casual Income – Gross Total Income – Total Income – Agricultural Income **Residential Status:** Determination of Residential Status of an individual (simple problems) - Incidence of Tax (Simple Problems on Computation of Gross Total Income). **Exempted Incomes:** Introduction – Exempted Incomes U/S 10 (Restricted to Individual Assessee) – Only theory	10 Hrs.	CO1	PO7	POS2 & POS3
Unit-2	**Income from Salary:** Meaning & Definition – Basis of Charge – Allowances – Fully Taxable Allowances – Partly Taxable Allowances - House Rent Allowance - Entertainment Allowance – Transport Allowance - Children Education & Hostel Allowances - Fully Exempted Allowances – Perquisites – Tax Free Perquisites – Perquisites Taxable in all Cases - Rent free accommodation - Concessional accommodation - Personal obligations of the employee met by the employer – Perquisites Taxable in Specified Cases – Gardener – Sweeper – Gas – Electricity - Water and Motor car facility (when the motor car is owned or hired by the employer)– Provident Funds – Deductions from Salary U/S 16 – Problems on Income from Salary(excluding retirement benefits).	16 Hrs.	CO2	PO7	POS2 & POS3
Unit-3	**Income from House Property:** Basis of Charge – Exempted Incomes from House Property – Annual Value – Determination of Annual Value – Loss due to Vacancy – Deductions from Annual Value – Problems on Income from House Property (Excluding Pre - Construction interest)	10 Hrs.	CO3	PO7	POS2 & POS3

Unit-4	**Income from Business and Profession and Total Income:** Meaning and Definition of Business & Profession – Expenses & losses Expressly Allowed – Expenses and losses Expressly Disallowed – Expenses Allowed on Payment Basis - Problems on computation of income from Business of Sole Proprietor. Income from **Capital Gains (**excluding exemptions **-** Theory only) **- Income from Other Sources** (Theory only) - Deductions **U/S 80 C, D & G**. Simple problems on Computation of Total income of an Individual	16 Hrs.	CO4	PO7	POS2 & POS3

Reference Books:

1. Dr. Vinod K. Singhania: Direct Taxes – Law and Practice, Taxman publication.
2. B.B. Lal: Direct Taxes, Konark Publisher (P) ltd.
3. Dr. Mehrotra and Dr. Goyal: Direct Taxes – Law and Practice, Sahitya Bhavan Publication.
4. DinakarPagare: Law and Practice of Income Tax, Sultan Chand and sons.

Course Title: Management Accounting					
Course Code: B20BB5020					
Course Description: Management Accounting is an essential tool that enhances a manager's ability to make effective economic decisions.					
Course Objectives: 1. To develop the knowledge of business finance and management decision. 2. To teach a sense of responsibility and a capacity for accounting for management. 3. To learn Ratio Analysis and different Ratios.					
Course Outcomes: After the completion of the course, students will be able to: CO1: Describe and apply the basic techniques of financial statement analysis. CO2: By depicting all inflows and outflows of fund, the statement shows their net impact on working capital of the firm. CO3: The uses of the statement of Cash flow and the cash flow classifications appearing on the Statement of Cash Flows. CO4: it will learn to analyze the importance of ratios in judging any company.					
Course Pre-requisites: Financial accounting and Cost accounting					
Pedagogy: ICT and Direct Method					
LTP: 3:0:1					
Course type: HC					
Contact Hours:52 Hrs.					
Units	**Detailed Syllabus**	**CH**	**CO**	**PO**	**PSO**

Unit-1	**Introduction to Management Accounting** Meaning – Definition- objectives- Nature and scope- Role of Management Accountant Relationship between Financial Accounting and Management Accounting - Relationship between cost Accounting and Management Accounting. **Analysis Of Financial Statements: -** Types of Analysis – Methods of Financial Analysis – Comparative Statements – Common Size Statements – Trend Analysis (Problems on financial analysis)	12 hrs.	CO1	PO2 & PO8	POS2 & POS3
Unit-2	**Fund Flow Statement:** Meaning and concept of Fund – Meaning and Definition of Fund Flow statement- Uses and Limitations of Fund flow Statement- Procedure of Fund Flow statement- Statement of Changes in Working Capital- Statement of Funds from operation – statement of Sources and Application of Funds (Problems on working capital & funds flow statement with adjustment)	14 hrs.	CO2	PO2 & PO8	POS2 & POS3
Unit-3	**Cash Flow Statement:** Meaning and Definition of Cash Flow Statement- Differences between cash flow Statement and Fund Flow Statement – Uses of Cash flow statement – Limitations of Cash Flow statement – Provisions of AS-3 – Procedure of Cash Flow Statement – Concept of Cash and Cash Equivalents – Cash flow from operating Activities – Cash flow from Investing Activities and Cash flow from Financing Activities – Preparation of Cash Flow Statement According To AS-3 (Problem on indirect Method Only)	14 hrs.	CO3	PO2 & PO8	POS2 & POS3
Unit-4	**Ratio Analysis:** Meaning and Definition of Ratio, Classification of Ratios, Uses and Limitations – (Problems on Ratio Analysis- Preparation of Financial statements with the help of Accounting Ratios)	12 hrs.	CO4	PO2 & PO8	POS2 & POS3

Reference Books:

1. M Y Khan, P K Jain- Management Accounting-7th Edition 2017-McGraw Hill Education
2. R.C Sekhar, A.V Rajgopalan- Management Accounting- 6th Edition2012- Oxford university publication
3. R.S.N Pillai Bagavathi – Management Accounting- 2nd Edition 2010- S chand & company
4. Khan M, Jain -Management Accounting-4th edition 2010- TMH

Course Title: Business Research Methodology

Course Code: B20BB5030

Course Description: All Business Management students require the ability to deal with quantitative material/data, including the collection, collation and analysis of such data. This course introduces students to the business research methods in business mainly centered on statistical aspects. It also provides them with experience in designing questionnaires and report writing. In order to effectively carry out statistical analysis, the students are required to have experience of computing. This course reinforces the experience gained in their Computing for Business course and is aimed at providing the basic understanding of the research methodology.

Course Objectives:

1. Gain knowledge and understanding of the basic framework of research process.
2. Comprehend research instruments and methodologies to apply to a specific research project
3. Apply essential skills in analyzing both quantitative and qualitative data.
4. Evaluate the importance of report writing and presentation in business research.

Course Outcomes:

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

CO1: Identify and apply different research approaches and methodologies

CO2: Develop data collection instrument according to the underlying theoretical framework

CO3: Interpret and present the results of an independently conducted statistical analysis.

CO4: Understand the process of report writing and presentation in business research.

Course Pre-requisites: Basic knowledge about Research.

Pedagogy: ICT and Direct Method

LTP: 3:0:1

Course type: HC

Contact Hours:52 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Research:** Meaning - Purpose and scope of Research - Steps in Research - identifying the research problem - concepts, Constructs and theoretical framework - Types and Methods of research. Review of Literature: Need - sources to collect review - how to write review of literature, survey using Internet.	12 Hrs.	CO1	PO5	POS1
Unit-2	**Data Collection:** Data Meaning - types of Data - Sources of Data - primary Data – Secondary data - Data collection instruments - Questionnaire-Interview Schedule Preparation model - Pilot study. Processing of Data: Editing Data, Coding, Classification of Data - Tabulation of Data.	14 Hrs.	CO2	PO5	POS1
Unit-3	**Sampling Techniques:** Census vs Sampling Characteristics of Good Sample - Advantages and Limitations of Sampling - Sampling Techniques or	14 Hrs.	CO3	PO5	POS1

	Methods (Probability and Non-Probability) - Sample design - Sampling frame - Criteria for selecting Sampling Techniques, sampling procedure, sample size and determination of sample size				
Unit-4	**Statistical Methods and Report Writing:** Hypothesis Testing - Concept - Need - Characteristics of Hypothesis - Types of Hypothesis- procedure for Hypothesis –hypothesis testing for means and proportions, Chi Square Test – ANOVA (theory and one-way table)- Report Writing - Introduction - types - Format - Principles of Writing report - Documentation: Footnotes and Endnotes – Bibliography. References	12 Hrs.	CO4	PO5	POS1

Reference Books:

1. Business Research Methods, S. L. Gupta, Hitesh Gupta, Tata McGraw Hill Education, 2020.
2. Research Methods for Business: A Skill Building Approach- Uma Sekaran, Roger Bougie,8/e, John Wiley & Sons, Limited, 2020.
3. Business Research Methods, Donald R. Cooper, Pamela S. Schindler, J.K. Sharma, 12/e (SIE), McGraw Hill Education,2019.
4. Research Methodology: Concepts and Cases-Deepak Chawla &Neena Sodhi, Vikas Publishing house Pvt Ltd; 2011.
5. Business Research Methods-Emma Bell, Alan Bryman, Bill Harley, Oxford University Press,2019.
6. C R Kothari, Gaurav Garg; Research Methodology, New Age International. 2019.

I. FINANCE SPECIALIZATION

Course Title: Financial Markets and Services
Course Code: B20BB5111
Course Description: The Course aims at providing the students, basic knowledge about the Finance concepts, markets and various services provided in those markets. The syllabus is structured in a way which provides adequate information about the roles of intermediaries and its regulating bodies. The course also provides information about the prevailing financial system in India.
Course Objectives: 1. To identify the functions of financial markets and institutions and examine their impact on Indian Economy. 2. To learn about different sources of funds available in India. 3. To learn about the mechanism of different investment service available in market.

Course Outcomes:
After the completion of the course, students will be able to:
CO1: Learn the mechanism of financial markets and their applications.
CO2: Elaborate the banking and non-banking services available to corporates.
CO3: Learn about the functioning of Mutual funds and SEBI
CO4: Explore the techniques of credit rating and modern financial services.

Course Pre-requisites: Basic knowledge of financial management concepts

Pedagogy: ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours: 39 Hours

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Financial Markets:** Primary Market - Meaning – Features – Players of Primary Market – Instruments in Primary Market (Names) – Procedure for issuing Equity and Debentures – SEBI guidelines towards the issue of Equity Shares and Debentures – Merits and Demerits of Primary Markets Secondary Market-Meaning – Structure – Functions – Trading and Settlement System of Stock Exchange Transactions – Players in the Stock Market – Merits and Demerits of Stock Markets – Reforms in Stock Market – OTCEI and NSE – Origin – Function – Merits Demerits.	12 Hrs.	CO1	PO2 & PO6	POS1
Unit-2	**Banking and Non – Banking Financial Intermediaries:** Banking financial institutions-commercial banks, functions, role in development of economy, Developmental financial institutions, and their role in economy development. Non-Banking Financial intermediaries. Investment and Finance Companies – Merchant Banks – Hire Purchase Finance – Lease Finance – Housing Finance – Venture Capital Funds and Factoring.	12 Hrs.	CO2	PO2 & PO6	POS1
Unit-3	**SEBI and Mutual Funds:** Objectives of SEBI - Organization – Functions and Functioning of SEBI – Powers of SEBI – Role of SEBI in marketing of Securities and Protection of Investor Interest. Concept of Mutual Funds – Growth of Mutual Funds in India – Mutual Fund Schemes – Money Market Mutual Funds – Private Sector Mutual Funds – Evaluation of the performance of Mutual Funds – Functioning of Mutual Funds in India.	09 Hrs.	CO3	PO2 & PO6	POS1
Unit-4	**Credit Rating and Recent Trends In Financial Services:** Credit rating: Meaning, advantages, need; methodology of credit rating process;	06 Hrs.	CO4	PO2 & PO6	POS1

	Personalized Banking – ATM – Tele-banking & E-banking – Credit and Debit Card – Customization of Investment Portfolio – Financial Planning: Introduction, Need, Advantages, essential elements of financial planning				

Reference Books:

1. Financial Markets and Institutions: Fedrick S. Mishkin, Tata Mc Graw Hill, 8th Edition, 2017
2. Vasant Desai: Financial Markets & Financial Services, Himalaya Publishing House, 2010
3. E Gardon& K Natarajan: Financial Markets & Services, 2016, HpH
4. Bharathi V Pathak, Indian Financial System, 2011, Pearson Education Delhi
5. M Y Khan, Indian Financial System, 2010, McGraw Hill

Course Title: Security Analysis and Portfolio Management

Course Code: B20BB5112

Course Description: The objective of this course is to introduce the intuition and concepts of Investment analysis and portfolio management. Allocation of resources and selection of resources being the two crucial decisions to be taken by the investors, the course helps the students to perform both the tasks successfully. Risk-return trade off being the decision-making tool, the course enables the students to identify the risks involved and forecasting the returns too. The course in all enables the students to successfully construct a diversified portfolio and make good and attractive returns over a time period.

Course Objectives:

1. Understand the basics of investment management
2. Understand the functions of stock market
3. Understand the difference between the operations of primary and secondary market
4. Calculate risk and return
5. To construct a diversified portfolio

Course Outcomes:

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

CO1: Classifying the securities and identifying the investment avenues.

CO2: To Perform the fundamental and technical analysis independently.

CO3: Identify the different types of risk and to calculate the returns.

CO4: To identify the stocks that are performing well and investing in stocks

Course Pre-requisites: Knowledge Indian Financial system, Primary and secondary markets

Pedagogy: ICT and Direct Method **Group Discussions,**

LTP: 2:1:0

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Investment Management:** Attributes, Economic vs. Financial Investment, Investment and speculation, Features of a good	10 Hrs.	CO1	2,5	POS1

	investment, Investment Process. Financial Instruments: Classification of Securities — Benefits of Investments and Diversification – Investment Strategies – Types of Companies and Stocks –Investment Avenues – types of investors, speculation v/s investments, Primary market, secondary market, BSE, NSE, Indices, Trading and Settlement Procedure				
Unit-2	**Security Analysis:** Introduction – Fundamental Analysis – Economic Analysis – Industry Analysis – Company Analysis, Technical Analysis – Dow Theory – Advanced Declined Theory – Chartism Assumptions of Technical Analysis. Technical analysis tools	9 Hrs.	CO2	2	POS1
Unit-3	**Risk and Return- Equity, Bonds and Preference Share:** Concept of Risk, Types of Risk- Systematic risk, Unsystematic risk, Calculation of Risk and returns individual security, Portfolio Risk and Return (Theory & Problems). Valuation of bonds and preference share: valuation of bonds, YTM, valuation of preference share, equity valuation-dividend valuation model, CAPM approach for valuation of cost of equity	10 Hrs.	CO3	2	POS2 & POS3
Unit-4	**Modern Portfolio Theory and Measures:** Introduction – Mean –Variance Model – Markowitz Model – Sharpe single index model – Capital Market Line – Market Portfolio – Capital Asset Pricing Model – Security Market Line – Beta Factor – Alpha and Beta Coefficient – Arbitrage Pricing Model. Sharpe's measure - Jensen's measure, -Treynor's measure.	10 Hrs.	CO4	2	POS2 & POS3

Reference Books:

1. Security analysis and portfolio management- Avadhani, 12/e, Himalaya Publishing House ,2015
2. Investment Management- C.K Bhalla, S. Chand ltd 13th edition
3. Security analysis and portfolio management, Punithavathy Pandian, Vikas Publishing House; Second edition (2012)
4. Security analysis and portfolio management, S Kevin, 2/e, PHI, 2015
5. Investment analysis and portfolio management- Prasanna Chandra, tat Mc Graw- Hill, 5/e, 2017
6. Security Analysis & Portfolio Management – Fisher and Jordan, 6/e, Pearson, 2011
7. Investments – ZviBodie, Kane, Marcus &Mohanty, 11/e, TMH,2019.

II . HUMAN RESOURCE SPECIALIZATION

Course Title: Employee Welfare And Social Security

Course Code: B20BB5211

Course Description: To gain knowledge about employee welfare and social security which is an indispensable part of organization. Specially in the Indian scenario, the Labor welfare and security is paramount in industrial relations solutions. There are modules with conceptual, descriptive, analytical and legal aspects.

Course Objectives:

1. To sensitize the students with the employee relations scenario in India.
2. To make student understand fundamental concepts of employee welfare and management.
3. To make student knowledgeable of historical development, theoretical aspects and practice applications of employee welfare process.
4. To acquaint the students with basic Acts pertaining to social security and labor welfare as applicable in India.

Course Outcomes:

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

CO1: To know the relevance and importance of employee welfare and social security

CO2: To understand the different kinds of legal frameworks which are available for ensuring employee welfare.

CO3: To understand the Various concepts available for ensuring employee welfare in the organization.

CO4: To understand the evolution of the concept of social security, Employee Welfare & Social Security.

Course Pre-requisites: Knowledge about HRM and basic labor laws

Pedagogy: Direct Method, ICT, Flipped classroom and case study discussions.

LTP: 2:1:0

Course type: SC

Contact Hours:39 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1:	**Evolution of labour welfare**: Classification of welfare work, agencies for welfare work. Welfare activities of govt. of India: welfare work by trade unions Labour welfare work by voluntary social organizations. **Labour administration:** agencies for administrating labour welfare laws in India. Case Studies should be discussed in class.	9 Hrs.	CO1	PO2 & PO6	POS1
Unit-2	**Factories Act 1948**: Scope, importance, features and implications as applicable in India Minimum Wages Act 1948: Scope, importance, features and implications as applicable in India Payment of Bonus Act 1965: Scope, importance, features and	10 Hrs.	CO2	PO2 & PO6	POS1

	implications as applicable in India Workman's Compensation Act 1923: Scope, importance, features and implications as applicable in India Maternity Benefit Act 1961: Scope, importance, features and implications as applicable in India				
Unit-3	**Employment State Insurance Act 1948:** Scope, importance, features and implications as applicable in India **Provident Fund & Miscellaneous Provision Act 1951**: Scope, importance, features and implications as applicable in India **Gratuity Act 1972:** Scope, importance, features and implications as applicable in India I.L.O and social Security.	10 Hrs.	CO3	PO2 & PO6	POS1
Unit-4	**Employee security and Welfare:** The concept of scope of social security. Social assistance and social insurance, Evolution of Social Security. The concept of Labour welfare: definition, Scope and Objectives, welfare work and social work. Payment of wages Act 1936: Scope, importance, features and implications as applicable in India	10 Hrs.	CO4	PO2 & PO6	POS1

Reference Books:

1. M. Sharma 'Social, Security Labour Welfare' (12th Edition) Himalayas Publishing House
2. C B Mamoria, "Dynamics of Industrial Relations" (16th Edition) Himalaya Publishing House
3. Memoria, CB and Memoria S, Industrial labour, social security and Industrial Peace in India,Himalaya, New Delhi.
4. Sinha G.P., Industrial Relations and Labour legislation in India, New Delhi.
5. Goswami V.G., Labour& Industrial Law, Central Law Agency, Allahabad.

Course Title: Organization Change & Development
Course Code: B20BB5212
Course Description: This course helps in understanding the basic theories and methods associated with organizational change and development in contemporary organizations. In this course, participants will be exposed to a number of organizational issues including, the need for change, why organizations change or fail to change, and how change helps organizations become more competitive and profitable. we explore and discuss the need and nature of planning for change, managing change, and measuring change in the context of many different situations, companies and industries.

Course Objectives:

1. To sensitize the students with the concepts of Organizational Change and Organizational Development
2. To acquaint the students with the basics of various OD Interventions
3. To familiarize the students to develop an understanding of the practices used by organizations to change and manage its development.
4. To understand the OD implementation and assessment process.

Course Outcomes:

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

CO1: Understand the basic concepts and the need for organization change

CO2: Analyze the importance of team work

CO3: Understand the importance of organizational interventions

CO4: Bring about the change process in the teams as team lead

Course Pre-requisites: Basic knowledge of HR subject

Pedagogy: Flip classes, case studies, anecdotes, ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours:39 hours

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Organizational development:** Organizational development: Definition, history of OD, values, assumptions and beliefs in OD; Foundations of OD: Models and Theories, Managing Change, empowerment, teams and team work, parallel learning structures.	9 Hrs.	CO1	PO2	POS1
Unit-2	**Organizational Interventions:** OD Interventions: Team Interventions, Intergroup Interventions, third-party peace-making intervention, Theory and Practice on change: Types & nature of change.	10 Hrs.	CO2	PO2	POS1
Unit-3	**Managing Organizational Development:** Managing OD Process: Action Research as a process and approach; Emotional Intelligence and employee productivity. Operational Components of OD: Resistance to change.	10 Hrs.	CO3	PO2	POS1
Unit-4	**Implementation and Assessment of OD:** Implementation conditions for failure and success in OD efforts: Assessment of OD and change in organizational performance: training experiences, T-groups and career planning, coaching and mentoring, Indian Experiences of OD in Public and Private Enterprises	10 Hrs.	CO4	PO2	POS1

Reference Books:

1. Cummings & Worley, "Organization Development & Change", EIGHTH EDITION, Thomson –South-Western
2. Cummings, Thomas G. & Christopher G. Worley (C & W). **Organization Development and Change**. 9th ed., West Publishing Co.: Minneapolis/St. Paul, 2008.
3. Wendell L. French, Robert A. Zawacki, Cecil H. Bell, "Organization Development and Transformation: Managing Effective Change" (2004 Edition) Mc-graw Hill
4. Kavita Singh, "Organization Change and Development", (1st Edition), Excel
5. Organization Development, Daniel Robey& Steven Actman, Macmillan.
6. Organization Development and Change, Cummins&Worley, Thomson, Cengage.
7. Organization Development Interventions& Strategies, S. Ramnarayan, T.V Rao &Kuldeepsingh

III- MARKETING SPECIALIZATION

Course Title: **International Marketing**
Course Code: B20BB5311
Course Description: This course will equip students with the tools and terminology to explore and understand marketing practices in a global environment. It will help students to learn the scope and challenge of International marketing, the dynamic environment of International trade, the culture, political, legal, and business systems of global markets.
Course Objectives: 1. To understand the International marketing conditions 2. To study the benefits of International marketing 3. To understand the International marketing environment 4. Analyze the International market entry strategies
Course Outcomes: After the completion of the course, students will be able to: CO1: Apply the porter's diamond model CO2: Analyze the factors affecting International market conditions CO3: Understand the International market entry strategies CO4: Understand the International marketing mix
Course Pre-requisites: Understanding on concepts of Trade theories, International Marketing Environment, Market entry strategies and International Marketing Mix
Pedagogy: ICT and Direct Method
LTP: 2:1:0
Course type: SC
Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to International Marketing:** Introduction, Meaning of International Marketing, Domestic Marketing vs. International Marketing, Benefits of International Marketing, Barriers. Trade Theories: Comparative and Absolute Advantage Theory Mercantilism, Porter's diamond model	11 Hrs.	CO1	PO3 & PO6	POS1
Unit-2	**International Marketing Environment:** Economic condition and indicators, Economic systems, Balance of payments, Policies and reforms, International Economic environment and trends Meaning and Characteristics of Culture, Implication of culture, Culture as barrier. Political environment, Legal environment, Political risk, Implication of political and legal environment on International marketing	10 Hrs.	CO2	PO3 & PO6	POS1
Unit-3	**Market Entry Strategies:** Market Entry strategies, Foreign Direct Investment, Exporting and Importing, Licensing, Joint Venture, Mergers, Acquisitions, Strategic Alliances, Turnkey	10 Hrs.	CO3	PO3 & PO6	POS1
Unit-4	**International Marketing Mix:** Product Development, Product diversification, Product customization, Branding decisions. Channel development, Channel decisions, Physical Distribution, Modes of Transportation, Clearing and Forwarding Price standardization, Pricing decision, Alternative pricing strategies, Dumping, Price Distortion, Inflationary impact, Transfer pricing, Price quotation and Terms of sale, means of payment, International Promotion Mix operations, Franchising marketing	8 Hrs.	CO4	PO3 & PO6	POS1

Reference Books:

1. International Marketing Management – An Indian Perspective,Sultan Chand & Sons,2015
2. Export Marketing, MichaelVaz, Manan Publication 2013
3. International Marketing, Francis Cherunilam, Himalaya publishing house,15th Edition, 2016
4. Cateora, P. Gilly, M. & Graham, J. International Marketing, 15th edition,2011
5. International Marketing Management: Text and Cases,U.C.Mathur,Sage Publications 20081. George Belch and Michael Belch, Advertising and Promotion: An Integrated Marketing Communications Perspective,12th Edition, McGraw Hill. 2019

Course Title: Advertising
Course Code: B20BB5312

Course Description: This course provides an introduction to the fundamentals of advertising with emphasis on conceptual process and development, and basic advertising methodologies and techniques. It also Emphasis on the application and evaluation of advertising principles and design.

Course Objectives:

1. To provide knowledge of basic concepts of advertising management.
2. To understand the various determinants of media and the creative process.
3. To gain knowledge about the measurement techniques of advertising effectiveness.
4. To understand the concept of advertising agency.

Course Outcomes:

CO1: Explain the concept, importance and types of advertising.

CO2: Identify the factors influencing creative and media decisions.

CO3: Apply pretesting and post testing process to measure the advertising effectiveness.

CO4: Elaborate on the importance and structure of advertising agency.

Course Pre-requisites: Basic knowledge about advertising concepts and media channels

Pedagogy: ICT and Direct Method

LTP: 2:1:0

Course type: SC

Contact Hours:39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Advertising:** Meaning - nature and importance of advertising - types and objectives - Audience selection - Setting of advertising budget - determinants and major methods - Communication process - basic and elements - Marketing Communication.	10 Hrs.	CO1	1	POS1
Unit-2	**Media Decisions and Development:** Major media types – their merits and demerits - Advertising through internet and interactive media - issue and considerations - Factors influencing media choice - media selection - media scheduling. Advertising creativity - Advertising appeals - Advertising copy and elements of print advertisement creativity.	10 Hrs.	CO2	5	POS1
Unit-3	**Measuring Advertising Effectiveness:** Arguments for and against measuring effectiveness - Advertising testing process - Evaluating communication and sales effects - Pre-and Post-testing techniques.	10 Hrs.	CO3	7	POS1
Unit-4	**Organisational Arrangement** Advertising Agency – Role - types and selection of advertising agency -	9 Hrs.	CO4	5	POS1

	Reasons for evaluating advertising agencies. Social ethical and legal aspects of advertising in India - Recent developments and issues in advertising.				

Reference Books:

1. George Belch and Michael Belch, Advertising and Promotion: An Integrated Marketing Communications Perspective,12th Edition, McGraw Hill. 2019
2. O'Guinn, Advertising and Promotion: An Integrated Brand Approach, 8th edition, Cengage Learning, 2019
3. Terence A. Shimp, Advertising and Promotion: An IMC Approach, South Western,9th edition, Cengage Learning.2013
4. Terence A. Shimp, Advertising and Promotion: An IMC Approach, 9th Edition, Cengage Learning.2013

V. Specialisation – International Business

Course Title : International Business Environment

Course Code: B20BB5411

Course Description:

Introduces the concept of international business as a system and the theories which underlie it in service sectors which are visual evidences of it such as production, marketing, financial, legal and other subsystems which comprise the total system of IB. It also examines national governmental and international institutional controls and constraints, which impact the environment in which the system operates. The successful search for new markets implies an appreciation of these issues and an understanding of the forces at work in the international business environment. We that includes the Economics and politics of international trade.

Course Objectives:

1. to enable the students learn nature, scope and structure of International Business
2. understand the influence of various environmental factors on international business operations.

Course Outcomes:

At the end of the course, student shall be able to-

CO1: Undestand the international business and its modes of entry
CO2: Analysing the international business environment.
CO3: Indentify the Global Trading and Investment Environment
CO4: elucidate on International Economic Institutions and Agreements, Regional Economic Groupings in Practice

Course Pre-requisites: International Marketing

Pedagogy: ICT

LTP: 2:1:0=3

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to International Business:** Importance, nature and scope of International business; Modes of entry into International Business;	9	1	1,4	1

	Internationalization process and managerial implications; Multinational Corporations and their involvement in International Business: Issues in foreign investments, technology transfer, pricing and regulations; International collaborative arrangements and strategic alliances.				
Unit-2	**International Business Environment:** Economic, Political, Cultural and Legal environments in International Business. Framework for analyzing international business environment. **Balance of Payment Account:** Concept and significance of balance of payments account; Current and capital account components and accounting system; Balance of payment deficits and correction policies.	10	2	1,3	2
Unit-3	**Global Trading and Investment Environment:** World trade in goods and services – Major trends and developments; World trade and protectionism – Tariff and non-tariff barriers; Foreign Investments-Pattern, Structure and effects; Movements in foreign exchange and interest rates and their impact on trade and investment flows.	10	2	4,6	2
Unit-4	**International Economic Institutions and Agreements:** WTO, WTO and Developing Countries, IMF, World Bank, UNCTAD, International commodity trading and agreements. **Regional Economic Groupings in Practice:** Levels of Regional Economic Integration; Regionalism vs. Multilateralism; Important Regional Economic Groupings in the World. **Contemporary Issues in International Business:** Labour and Environmental Issues.	10	2	4,5	3

Reference Books:

1. Bennet, Roger, International Business, Financial Times, Pitman Publishing, London.
2. Bhattacharya, B., Going International: Response Strategies of the Indian Sector, Wheeler Publishing, New Delhi.
3. Czinkota, Michael R., et. al., International Business, the Dryden Press, Fortworth.
4. Danoes, John D. and Radebaugh, Lee H., International Business: Environment and Operations, Addison Wesley, Readings.
5. Hill, Charles W. L., International Business, McGraw Hill, New York.

Course Title: Global Operations and Logistics

Course Code: B20BB5412

Course Description: In this course, we discuss operations function in global context. Operations function is one of the three primary functions of any organization, along with marketing and finance.

Course Objectives:

1.The course will present concepts, tools, and strategies used to design and manage operations in global contexts and also Global Logistics will familiarize students with the role of International

Logistics in the context of Supply Chain.
2.Students will learn how Logistics impact in other areas of International Supply Chain Management, Methods of Entry into Foreign Markets, Info terms, International Commercial Documents and International Insurance.
3. Additional areas covered in Global Logistics may include International Modes of Transportation, Packaging, and Security.

Course Outcomes:

At the end of the course, student shall be able to-

Co:1 The intent is to give the insights of ideas and techniques an opportunity to students, related to the design, planning, control and improvement of operations

Co:2 To become familiar with the language of international operations and supply chain management;

Co:3 To strengthen critical thinking and visualize the role of operations in inventory and warehousing

Co:4 To enhance operations capabilities that enable the firm to achieve sustaining competitive advantage vis-àvis its global.

Course Pre-requisites: Familiarity of Operations Management

Pedagogy: ICT, flipped classes

LTP: 2:1:0

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Global Operations and Logistics**: Meaning of Global Operations, Global Operations Management, Globalization and International Trade, Global Operations Strategy, Global Logistics: Meaning, Global logistics Management, and Global Sourcing and Procurement, Supply Chain Strategies	9	1	**1,4**	**1**
Unit-2	**Global Logistics and Supply Chain**: Role of global logistics Transportation Service providers, Reverse logistics Connecting to compete – Trade Logistics in the Global Economy, Transportation in Supply Chain, Measuring and Managing Logistics, Supply Chain Vulnerability, Risk, Robustness and Resilience, Sustainability Logistics and Supply Chain	10	2	**3,4**	**1**
Unit-3	**Inventory and Warehouse Management**: Inventory Management, Warehouse Management and Material Handling, Global Operations: Make or buy decisions Centralized and decentralized operations, Role of Operations, Offshoring and reshoring, Information Flows and Technology	10	3	**2,4**	**2**
Unit-4	**Emergent Markets and Global Competitiveness**: Infrastructure and Country Competitiveness, The global competitiveness, Competitive priorities Legal Considerations and Contracts, Global Value Chains,	10	4	**4,5**	**3**

	The emerging supply chain strategies, Sustainability issues in Global Operations Management, Risk and Safety in Global Operations				

Reference Books:

1. Mangam, Lalwani, Butcher, & Javadpou, global Logistics and Supply Chain Management ,2nd Edition, John Wiley & Sons, 2nd Edition, 2011
2. HULT, T.; CLOSS, D.; FRAYER, D. Global Supply Chain Management Leveraging processes, measurements and tools for strategic corporate advantage. McGraw Hill. 2013.
3. DAVID, Pierre., International logistics – the management of international trade operations. 4 th Edition, Ciccero Books, 2013.
4. DORNIER, Phillipe-Pierre, Ernst, R., Fender, M., Kouvelis P. Global Operations and Logistics Text and cases. 1st. ed., 1998

SIX SEMESTER

Course Title: Business Policy and Strategic Management

Course Code: B20BB6010

Course Description: The course is designed to explore an organization's vision, mission, examine values, techniques and models of organizational and environmental analysis, discuss the theory and practice of strategy formulation and implementation.

Course Objectives:

1. Understand the meaning &strategies that the organizations adopt for longevity success
2. Understand the external environment of the organization which influences its strategic choices.
3. Understand the factors that ensure strategic implementation success in organization
4. Understand the strategic control function and key success factor of organization.

Course Outcomes:

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

CO1: Able to understand the role of vision, mission and value of a company

CO2: Perform Industry analysis & SWOC of the company

CO3: Understand the strategic choices at various level of strategic management in organization.

CO4: Understand the factors responsible for success and sustainability for long term growth.

Course Pre-requisites: Basics Management principles

Pedagogy: Lecture, guest lectures, Direct Method, presentations, discussions

LTP: 3:1:0

Course type: HC

Contact Hours:52 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO

Unit-1	**Introduction to Business Policy and Strategy:** Introduction, Definition of Business Policy, Factors influencing Business Policy, Overview of Business Policies, Importance of Business Policies, Definitions of Policy, Procedures, Process and Programmes, Types of Policies, Business Policy Statements, Corporate Culture, Business Policy vs. Strategy, Policy decisions and their impact on Business Strategies ,Concept of Business Strategy, Need for Business Strategy, Functions of Business Strategies, Factors Considered Before Framing Business Policies, Steps Involved in Framing Business Policies, Policy Cycle and its Stages, Implementation of Policy Change, Role of Policies in Strategic Management, Business Policy and Decision Making.	12 Hrs.	CO1	1	POS1
Unit-2	**Business Continuity Plan and Investment Strategies and Ethics:** Introduction, Concepts of Business Continuity Plan (BCP), Relevance and Importance of BCP, Steps in Business Continuity Plan, Business Impact Areas, BCP and its Influence on Strategic Management, BCP and its Influence on Policy Making, Contingency Planning, Business Plan and Business Venture, Business Investment Strategies, Ethics and Values, Ethical Conduct and Unethical Conduct, Impact of Ethical Conduct, Corporate Social Responsibilities (CSR), Business obligations, Social Audit and Corporate Governance.	14 Hrs.	CO2	7	POS1
Unit-3	**Challenges and Recent Trends in Strategic Management:** Introduction, Strategic Management as an Organizational Force, Dealing with Strategic Management in Various Situations, Strategic Management Implications and Challenges, Recent Trends in Strategic Management: Introduction, Strategic Thinking, Organizational Culture and its Significance, Organizational Development and Change, Change Management, Models of Leadership Styles and its Roles, Strategic management in a new globalized economy. Strategic Planning Process, Expansion or Growth, Mergers and Acquisitions, Issues in Strategy Implementation.	14 Hrs.	CO3	1	POS1
Unit-4	**Strategies for Multinational Corporations and Alliances:**	12 Hrs.	CO4	1	POS1

	Introduction, Multinational Corporations (MNCs), Benefits of MNCs, Limitations of MNCs, Business Strategies of MNCs, Techniques Employed by MNCs to Manage Markets, MNC, TNC and Global Companies, Strategic Alliances, Types of Strategic Alliances and Business Decisions, Problems Involved in Strategic Alliances, Strategy Analysis and its Importance, Environmental Appraisal and Scanning Techniques, organizational Position and Strategic Advantage Profile, Strategic Management Model.				

Reference Books:

1. Thomas L. wheelen and Hunger J. David Concepts in Strategic Management and Business Policy,Pearson Education Asia, New Delhi, 2012

2. Business Policy and Strategic Management,15e By AzharKzami,Tata McGraw-Hill Publishingcompany Limited, 2009

3. Business policy and Strategic management by SukulLomash and P K Mishra, Vikas Publishing House Pvt Ltd, 2007

4. Business policy and Strategic management by P. Subba Rao, Himalaya publishing House, 2011

Course Title: Entrepreneurship & Innovation Management
Course Code: B20BB6020
Course Description: This course is specifically offered for the final year students because during the end of the program, students can either join an organization or start up a venture on their own. Keeping this in mind, this course has been designed and offered. It basically helps students to develop entrepreneurial mindset with creative thinking.
Course Objectives: 1. To develop a sound understanding on the concepts of Entrepreneurship. 2. To identify the business opportunities around the society. 3. To Prepare a feasible business plan.
Course Outcomes: After the completion of the course, students will be able to: CO1: Comprehend the concepts of Entrepreneurship; CO2: Draw a feasible business plan. CO3: Compare and contrast Innovation and Creativity. CO4: Apply ERRC framework for organizations.
Course Pre-requisites: Principles of Management; Basic courses of Marketing and Finance.

Pedagogy: ITC, Group discussion and Direct Method					
LTP: 3:1:0					
Course type: HC					
Contact Hours:52 hrs.					
Units	**Detailed Syllabus**	**CH**	**CO**	**PO**	**PSO**
Unit-1	**ENTREPRENEURSHIP** Introduction – Why is Entrepreneurship required? Relevance of Entrepreneurship in the current scenario -Functions and responsibilities of Entrepreneur - Factors influencing Entrepreneurship – Charms and challenges of Entrepreneurship – Qualities of a successful Entrepreneur – Most successful entrepreneurs of India.	12 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Starting a new venture on your own** Sources of new ideas, ways of generating ideas, creative problem solving, spotting opportunities; environmental scanning, competitor, sales and industry analysis; feasibility study – market feasibility, financial feasibility; technical/operational feasibility, drawing a feasible business plan; presenting business plan to investors.	14 Hrs.	CO2	PO2 & PO3	POS1
Unit-3	**Creativity & Innovation** Meaning and differentiation - Drivers of innovation - Role of innovation in Entrepreneurship - Innovation process - Types of Innovation: Product innovation, process innovation and service innovation. Radical, incremental and disruptive Innovation, frugal innovation (Case study from Indian context on each type of innovation).	14 Hrs.	CO3	PO2 & PO3	POS1
Unit-4	**Innovation: A strategic framework** Analyzing innovative ideas through Porter's Five Forces Model; John Mullin's 7 Domain framework; Osterwalder's Business Development Model - Red Ocean Strategy – Blue Ocean Strategy with a case study from international context; ERRC framework; Applying ERRC framework for the existing Indian organizations;	12 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. Robert D Hisrich, 'Entrepreneurship', 9th edition, Tata M'c Graw Hill.
2. Scarborough/Cornwell, 'Essentials of Entrepreneurship & Small Business Management', 8th edition, Pearson Education India.
3. Peter F Drucker, 'Innovation & Entrepreneurship - Practice & Principles'
4. Abhishek Nirjar, 'Entrepreneurship Development', latest edition

5. David Holt, Entrepreneurship – New Venture Creation, PHI.
6. DF Kuratko and TV Rao, Entrepreneurship: A South Asian Perspective, Cengage Learning.

B20BB6080	**Major Project (Based on Specialization)**	**HC**	**0**	**2**	**8**	**10**
Chapters	**Chapter Content**		**PO**			
Chapter I	Introduction		PO5			
Chapter 2	Industry and Company Profile		PO5			
Chapter 3	Research Methodology		PO5			
Chapter 4	Data Analysis and Interpretation		PO5			
Chapter 5	Summary of Findings, Recommendations and Conclusion		PO8			

OR

Course Title: Business Policy and Strategic Management
Course Code: B20BB6010
Course Description: The course is designed to explore an organization's vision, mission, examine values, techniques and models of organizational and environmental analysis, discuss the theory and practice of strategy formulation and implementation.
Course Objectives: 1. Understand the meaning &strategies that the organizations adopt for longevity success 2. Understand the external environment of the organization which influences its strategic choices. 3. Understand the factors that ensure strategic implementation success in organization 4. Understand the strategic control function and key success factor of organization.
Course Outcomes: After the completion of the course, students will be able to: CO1: Able to understand the role of vision, mission and value of a company CO2: Perform Industry analysis & SWOC of the company CO3: Understand the strategic choices at various level of strategic management in organization. CO4: Understand the factors responsible for success and sustainability for long term growth.
Course Pre-requisites: Basics Management principles
Pedagogy: Lecture, guest lectures, Direct Method, presentations, discussions
LTP: 3:1:0

Course type: HC

Contact Hours:52 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to Business Policy and Strategy:** Introduction, Definition of Business Policy, Factors influencing Business Policy, Overview of Business Policies, Importance of Business Policies, Definitions of Policy, Procedures, Process and Programmes, Types of Policies, Business Policy Statements, Corporate Culture, Business Policy vs. Strategy, Policy decisions and their impact on Business Strategies ,Concept of Business Strategy, Need for Business Strategy, Functions of Business Strategies, Factors Considered Before Framing Business Policies, Steps Involved in Framing Business Policies, Policy Cycle and its Stages, Implementation of Policy Change, Role of Policies in Strategic Management, Business Policy and Decision Making.	12 Hrs.	CO1	PO1	POS1
Unit-2	**Business Continuity Plan and Investment Strategies and Ethics:** Introduction, Concepts of Business Continuity Plan (BCP), Relevance and Importance of BCP, Steps in Business Continuity Plan, Business Impact Areas, BCP and its Influence on Strategic Management, BCP and its Influence on Policy Making, Contingency Planning, Business Plan and Business Venture, Business Investment Strategies, Ethics and Values, Ethical Conduct and Unethical Conduct, Impact of Ethical Conduct, Corporate Social Responsibilities (CSR), Business obligations, Social Audit and Corporate Governance.	14 Hrs.	CO2	PO 7	POS1
Unit-3	**Challenges and Recent Trends in Strategic Management:** Introduction, Strategic Management as an Organizational Force, Dealing with Strategic Management in Various Situations, Strategic Management Implications and Challenges, Recent Trends in Strategic Management: Introduction, Strategic Thinking, Organizational Culture and its Significance, Organizational Development and Change, Change Management, Models of Leadership Styles and its Roles, Strategic management in a new globalized economy. Strategic Planning Process, Expansion or Growth, Mergers	14 Hrs.	CO3	PO 1	POS1

	and Acquisitions, Issues in Strategy Implementation.				
Unit-4	**Strategies for Multinational Corporations and Alliances:** Introduction, Multinational Corporations (MNCs), Benefits of MNCs, Limitations of MNCs, Business Strategies of MNCs, Techniques Employed by MNCs to Manage Markets, MNC, TNC and Global Companies, Strategic Alliances, Types of Strategic Alliances and Business Decisions, Problems Involved in Strategic Alliances, Strategy Analysis and its Importance, Environmental Appraisal and Scanning Techniques, organizational Position and Strategic Advantage Profile, Strategic Management Model.	12 Hrs.	CO4	PO 1	POS1

Reference Books:

1. Thomas L. wheelen and Hunger J. David Concepts in Strategic Management and Business Policy, Pearson Education Asia, New Delhi, 2012

2. Business Policy and Strategic Management,15e By AzharKzami, Tata McGraw-Hill Publishingcompany Limited, 2009

3. Business policy and Strategic management by SukulLomash and P K Mishra, Vikas Publishing House Pvt Ltd, 2007

4. Business policy and Strategic management by P. Subba Rao, Himalaya publishing House, 2011

Course Title: Entrepreneurship & Innovation Management

Course Code: **B20BB6020**

Course Description:

This course is specifically offered for the final year students because during the end of the program, students can either join an organization or start up a venture on their own. Keeping this in mind, this course has been designed and offered. It basically helps students to develop entrepreneurial mindset with creative thinking.

Course Objectives:

1. To develop a sound understanding on the concepts of Entrepreneurship.
2. To identify the business opportunities around the society.
3. To Prepare a feasible business plan.

Course Outcomes:

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

CO1: Comprehend the concepts of Entrepreneurship;
CO2: Draw a feasible business plan.
CO3: Compare and contrast Innovation and Creativity.
CO4: Apply ERRC framework for organizations.

Course Pre-requisites: Principles of Management; Basic courses of Marketing and Finance.

Pedagogy: ITC, Group discussion and Direct Method

LTP: 3:1:0

Course type: HC

Contact Hours:52 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**ENTREPRENEURSHIP** Introduction – Why is Entrepreneurship required? Relevance of Entrepreneurship in the current scenario -Functions and responsibilities of Entrepreneur - Factors influencing Entrepreneurship – Charms and challenges of Entrepreneurship – Qualities of a successful Entrepreneur – Most successful entrepreneurs of India.	12 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Starting a new venture on your own** Sources of new ideas, ways of generating ideas, creative problem solving, spotting opportunities; environmental scanning, competitor, sales and industry analysis; feasibility study – market feasibility, financial feasibility; technical/operational feasibility, drawing a feasible business plan; presenting business plan to investors.	14 Hrs.	CO2	PO2 & PO3	POS1
Unit-3	**Creativity & Innovation** Meaning and differentiation - Drivers of innovation - Role of innovation in Entrepreneurship - Innovation process - Types of Innovation: Product innovation, process innovation and service innovation. Radical, incremental and disruptive Innovation, frugal innovation (Case study from Indian context on each type of innovation).	14 Hrs.	CO3	PO2 & PO3	POS1
Unit-4	**Innovation: A strategic framework** Analyzing innovative ideas through Porter's Five Forces Model; John Mullin's 7 Domain framework; Osterwalder's Business Development Model - Red Ocean Strategy – Blue Ocean Strategy with a case study from international context; ERRC framework; Applying ERRC framework for the existing Indian organizations;	12 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. Robert D Hisrich, 'Entrepreneurship', 9th edition, Tata M'c Graw Hill.
2. Scarborough/Cornwell, 'Essentials of Entrepreneurship & Small Business Management', 8th edition, Pearson Education India.
3. Peter F Drucker, 'Innovation & Entrepreneurship - Practice & Principles'
4. Abhishek Nirjar, 'Entrepreneurship Development', latest edition
5. David Holt, Entrepreneurship – New Venture Creation, PHI.
6. DF Kuratko and TV Rao, Entrepreneurship: A South Asian Perspective, Cengage Learning.

Course Title: Goods and Service Tax

Course Code: B20BB6030

Course Description: This course is new scheme of indirect taxes. It is finance specialization course which will help the students to upgrade the current provision of indirect taxes in India. It will also help them in preparing for other certification courses.

Course Objectives:

1. To acquire the ability to learn the various concepts of GST law.

2. To learn their implications on various business decision making.

Course Outcomes:

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

CO1: To understand the various provision of GST.

CO2: To understand the provision of levying and collection of taxes.

CO3: Compute the value of time of supply and learn GST network portal

CO4: Learn the various provision of Input Tax Credit, and compute the value of Assessment of returns.

Course Pre-requisites: Students should have study Direct taxes in previous semester.

Pedagogy: ICT, Direct Method

LTP: 3:0:1

Course type: HC

Contact Hours:52 Hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Introduction to GST:** Overview of GST- Key concepts of GST Act-Features of GST- Need for GST in India- Pros &Cons of GST implementation in India-Objectives- taxes subsumed in GST- Dual GST Model- Structure of GST (SGST, CGST, IGST, UTGST)- Powers and Functions. GST ACT 2019: Overview of GST Act 2019- Salient features of CGST Act, SGST Act (Karnataka State), IGST Act. Important Definitions under GST Act- Actionable claim, Address of Delivery, Aggregate Turnover, Agriculturalist, Associated enterprises, Business, GST Council, Credit note and Debit note, Deemed Exports, Draw-back, Electronic Credit Ledger, Exempt supplies, Input, Input service, ISD, Input tax, Input Tax Credit, Job work, Intra-state supply of goods, Reverse charge, Invoice, Composition scheme, Person, Turnover in state.	12 Hrs.	CO1	PO7	POS2 & POS3
Unit-2	**Levy and collection of Taxes:** Supply: meaning	14 Hrs.	CO2	PO7	POS2

	and Scope of Supply, types of supply, treatment of mixed & composite Supply, Liability of tax payable person, Rate and value of tax, transactions without considerations, List of transactions for supply of goods & services and list of transactions for non-supply of goods & services- Reverse Charge Mechanism. **(problems on mixed and composite supply)**				& POS3
Unit-3	**Time of supply, GST network and technology:** Introduction- time of supply-forward charge, Reverse charge, residuary, special charges Time of supply of service- forward charge, reverse charge, Vouchers, Residuary, Special charges. Problems on determination of time of supply. GST NETWORK: Structure, Vision and Mission, Powers and Functions, Goods & Service Tax Suvidha Providers (GSP): Concepts, Framework and Guidelines and architecture to integrate with GST system- GSP Eco system. (**problems on time of supply)**	12 Hrs.	CO3	PO7	POS2 & POS3
Unit-4	**Input Tax and Credit, Assessment and Returns Input Tax:** Meaning, conditions for taking credit, ineligible input tax credit, availability of credit in special circumstances, input tax credit and change in constitution of registered person, taking input tax credit in respect of inputs and capital goods sent for job work, Manner of Distribution of Credit by Input Service Distributor (ISD). Overview of Assessment, returns- Types Furnishing details of outward supplies and Inward supplies, claim on ITC, matching reversal and reclaim of ITC, Steps for Filing forms, Levy of late fee. (**Problems on Assessment of tax and tax liability)**	14 Hrs.	CO4	PO7	POS2 & POS3

Reference Books:

1. Datey V.S.: GST Ready Reckoner, Taxman Publication, New Delhi Koolwal,
2. Ashish &Ritu: Goods and Services Tax (2017) Commercial Law Publisher (India) Pvt. Ltd.
3. GST: Dr. H.C. Mehrotra and Prof. V.P. Agarwal, Sahitya Bhawan Publications (2019)
4. GST Law & Practice: C A Nitesh Parashar, Anuj Harshwardhan Sharma Bharat Law House 2nd edition (2019)
5. GST: Dr. Thomas Joseph Thoomkuzhy, Dr. Jaya Jacob, Ms. Chinnu Mariam Chacko, Himalaya Publication House, 2nd edition (2019)

Course Title: Entrepreneurship & Innovation Management

Course Code: B20BB6040

Course Description:

This course is specifically offered for the final year students because during the end of the program, students can either join an organization or start up a venture on their own. Keeping this in mind, this course has been designed and offered. It basically helps students to develop entrepreneurial mindset with creative thinking.

Course Objectives:

1. To develop a sound understanding on the concepts of Entrepreneurship.
2. To identify the business opportunities around the society.
3. To Prepare a feasible business plan.

Course Outcomes:

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

CO1: Comprehend the concepts of Entrepreneurship;
CO2: Draw a feasible business plan.
CO3: Compare and contrast Innovation and Creativity.
CO4: Apply ERRC framework for organizations.

Course Pre-requisites: Principles of Management; Basic courses of Marketing and Finance.

Pedagogy: Direct Method, ITC, Group discussion

LTP: 3:1:0

Course type: HC

Contact Hours:52 hrs.

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	**Entrepreneurship:** Introduction – Why is Entrepreneurship required? Relevance of Entrepreneurship in the current scenario -Functions and responsibilities of Entrepreneur - Factors influencing Entrepreneurship – Charms and challenges of Entrepreneurship – Qualities of a successful Entrepreneur – Most successful entrepreneurs of India.	12 Hrs.	CO1	PO2 & PO3	POS1
Unit-2	**Starting a new venture on your own:** Sources of new ideas, ways of generating ideas, creative problem solving, spotting opportunities; environmental scanning, competitor, sales and industry analysis; feasibility study – market feasibility, financial feasibility; technical/operational feasibility, drawing a feasible business plan; presenting business plan to investors.	14 Hrs.	CO2	PO2 & PO3	POS1
Unit-3	**Creativity & Innovation:** Meaning and differentiation - Drivers of innovation - Role of innovation in Entrepreneurship - Innovation process - Types of Innovation: Product innovation, process	14 Hrs.	CO3	PO2 & PO3	POS1

	innovation and service innovation. Radical, incremental and disruptive Innovation, frugal innovation (Case study from Indian context on each type of innovation).				
Unit-4	**Innovation: A strategic framework**: Analyzing innovative ideas through Porter's Five Forces Model; John Mullin's 7 Domain framework; Osterwalder's Business Development Model - Red Ocean Strategy – Blue Ocean Strategy with a case study from international context; ERRC framework; Applying ERRC framework for the existing Indian organizations;	12 Hrs.	CO4	PO2 & PO3	POS1

Reference Books:

1. Robert D Hisrich, 'Entrepreneurship', 9th edition, Tata M'c Graw Hill.
2. Scarborough/Cornwell, 'Essentials of Entrepreneurship & Small Business Management', 8th edition, Pearson Education India.
3. Peter F Drucker, 'Innovation & Entrepreneurship - Practice & Principles'
4. Abhishek Nirjar, 'Entrepreneurship Development', latest edition
5. David Holt, Entrepreneurship – New Venture Creation, PHI.
6. DF Kuratko and TV Rao, Entrepreneurship: A South Asian Perspective, Cengage Learning.

Course Title: Project Management
Course Code: B20BB6050
Course Description: This course will provide a general introduction to project management. This course will equip the students to various feasibility analyses – Market, Technical, Financial and Economic, Students will discover the project life cycle and learn how to build a successful project from pre-implementation to completion. It will introduce project management topics such as resources, costs, time constraints and project scopes.
Course Objectives: 1. To equip them with the knowledge and skills required to be successful in applying Project Management. 2. To make them understand techniques for Project planning, scheduling and Execution Control 3. To make them understand the concepts of Project Management for planning to execution of projects and to make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation. 4. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting, Methodologies in Indian context.

Course Outcomes:
On successful completion of this course students shall be able to:
CO1: Identify the resources needed for each stage, including involved stakeholders, tools and supplementary materials

CO2: provide information regarding project costs by considering factors such as estimated cost, variances and profits

CO3: Understand the environmental impact on infrastructure projects.
CO4: Analyze the environmental issues which have an impact on the execution of Project Management.

Course Pre-requisites: Production and operation Management, Cost Analysis, MOB

Pedagogy: ICT and Direct Method

LTP: 2:0:1

Course type: SC

Contact Hours: 39

Units	Detailed Syllabus	CH	CO	PO	PSO
Unit-1	I**ntroduction to Applied Project Management:** Project Definition, Project Feasibility Analysis, developing a Project Execution Plan, Setting up a Project Organization Project Identification, Project Formulation, Project Selection, Project Planning, Project Appraisal, Project Implementation and Integrated Project Management,	9 Hrs.	CO1	PO8	POS1
Unit-2	**Resource Scheduling, and Cost Estimating**: Controlling Project Execution, Project Control, Project Planning and Scheduling Module, Project Cost Engineering and Detailed Engineering, Project Success and Failure, Project Auditing and Project Termination, E- Tendering	10 Hrs.	CO2	PO8	POS1
Unit-3	**Project Procurement and Construction Management**: Construction, Progress, Productivity and Supervision, Subcontract Administration and Control, Human aspects of project management – Project Monitoring and Control, Project Evaluation, Prerequisites for successful project implementation	10 Hrs.	CO3	PO8	POS1
Unit-4	**Project Leadership, Audit and Closure Project Leadership:** Managing vs Leading a project,	10 Hrs.	CO4	PO8	POS1

	managing project stake holders, Qualities of an effective project manager, managing project teams, Issues arising out of globalization, Communication, Conflict management. Project Audit and Closure: Audit process, project closure, project documentation, evaluation of project manager, team and members.				

Reference Books:

1. Prasanna Chandra; Projects- Planning, Analysis, Selection, Financing, Implementation and Review', VI Edition, Tata Mc Graw Hill, 8th Edition 2015

2. Chaudhary S.; Project Management, Tata Mc Graw Hill

3. Kerzner H.; Project Management, II Edition, CBS Publishers

4. Meredith Jack R., Mantel Samuel J.; Project Management, IV Edition, John Wiley & Sons

5. Gopalakrishnan P., Ramamurthy V.E; Textbook of Project Management, MacMillan Publishers

Course Title: Public Relations Management
Course Code: B20BB6070
Course Description: This course is designed to enable building and managing the relationships of a company or an organization with both its customers and non-customer publics including the media, community, government, investors, distributors, and employees etc. The course is designed to encourage students to consider the place of theory within PR practice and to apply the theories on real case analysis.
Course Objectives: 1. To increase understanding of the major perspectives in public relations practice and management. 2. To develop skills in applying public relations management principles to a variety of organizational situations and circumstances. 3. To increase understanding of the issues of multiculturalism and diversity related to public relations.
Course Outcomes: After the completion of the course, students will be able to: CO1: Knowledgeably discuss the origins, purpose, and various components of effective public relations. CO2: Prepare a comprehensive public relations plan based on situational factors. CO3: Craft a range of communications that serve target audiences by selecting suitable outlets and proper message format for media relations. CO4: Develop appropriate systems of public relations in the organization to cater to various issues.
Course Pre-requisites: Basic Understanding of Marketing Concepts (optional)
Pedagogy: ICT, Interactive Learning / Flipped Classroom, and Case Studies.Direct Method
LTP: 2:1:0

Course type: SC					
Contact Hours:39					
Units	**Detailed Syllabus**	**CH**	**CO**	**PO**	**PSO**
Unit-1	**Public Relations:** Meaning – Importance – Objectives – Scope and Functions – Difference between PR, Marketing and Advertising – Evolution of Public Relations –Models & Approaches of Public Relations – Subfunctions of Public Relations – Trends in Modern Public Relations	9 Hrs.	CO1	PO7	POS1
Unit-2	**Public Relation Strategy:** Concept – Importance – Strategy for PR Marketing of Products and Services, PR Strategy for Creating Corporate Image – Crisis Communication &Strategy for Damage Control– Public Relation Activities Before, During & After General Meetings of Corporate Bodies – Public Meetings – Event Management– Case Study of Corporates in India.	10 Hrs.	CO2	PO7	POS1
Unit-3	**Public Relations Communications:** Concept– Importance –Customer Care& Complaint Handling - Public Relations Materials & its Importance – Organizing Press Conferences – Electronic Media Coverage - Participation in Trade Fairs & Trade Exhibitions – Communication Skills – Contents of PR Presentation – Feedback Analysis – Information Management – Sources – Importance.	10 Hrs.	CO3	PO7	POS1
Unit-4	**Public Relations Management:** Public Relations Management – Ethics – Do's & Don'ts in Public Relations Management – Customers & Investors Education – Selection & Importance of Brand Ambassadors –Right to Information – Consumerism – NGO Activism – Code of Conduct in Advertisement – Outsourcing of Public Relations: Importance, Selection, Control.	10 Hrs.	CO4	PO7	POS1

Reference Books:

1. Theaker, Alison (2001). The Public Relations Handbook (Second Edition), Routledge. PDF copy available:
2. McKee, K.B., & Lamb, L. (2009). Applied Public Relations: Cases in Stakeholder Management (Second Edition). New York, New York: Routledge.
3. Sriramesh, K. (2004). Public relations in Asia: An anthology. Singapore: Thomson Learning Asia.
4. Lattimore, D. (2011). Public relations: The profession and the practice. New York: McGraw-Hill.
5. VanSlyke, T. J., &Kruckeberg, D. (2000). This is PR: The realities of public relations. Belmont, California: Wadsworth-Thomson Learning.
6. Mehta, D. S. (1980). Handbook of public relations in India: A standard guide for teachers, students and public relations personnel. New Delhi: Allied Publishers.

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