B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF CIVIL ENGINEERING

Academic Year 2019-20

Name of the Programme	B.E. in Civil Engineering
Programme Specific Outcomes (PSOs)	1. Analyze and design Buildings and Transportation systems. 2. Become environmentally and socially responsible citizens with awareness of the use of sustainable material and technologies and provide alternate engineered solutions. 3. To design water supply and sewerage systems
Programme Outcomes (POs)	PO1: Engineering Knowledge: Apply the knowledge of mathematics, science engineering fundamentals, and an engineering specialization to the solution complex engineering problems. PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. PO3: Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4: Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information provide valid conclusions. PO5: Modern tool usage: Create, select and apply the appropriate techniques, resources and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of limitations. PO6: The Engineering and Society: Apply the 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. PO7: 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. PO8: Ethics: Apply the ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

	PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings. PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions. PO11: Project Management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12: 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.
Course Names	**Course Outcomes (COs)**
3rd Semester	
19CV3BSMAT Engineering Mathematics-III	CO1: Apply Numerical techniques to solve problems arising in CO2: Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms. CO3: Apply the concepts of calculus to functional.
19CV3ESGEO Engineering Geology	CO1: Explain the Internal structure of the earth. Identify and classify minerals and rocks. CO2: Provide decision support on Lithological characters and related groundwater conditions. CO3: Describe various geological maps and interpretation of geological data for mining and mineral excavations, tunneling and other civil engineering projects
19CV3PCBMC Building materials and construction	CO1: Discuss the physical and mechanical properties of a variety of construction materials. CO2: Explain the functional components of a building. CO3: Describe the construction process of various components of a building. CO4: Conduct experiments to determine properties of civil engineering materials.
19CV3PCGDY Geodesy	CO1:Explain concepts of linear, direction, angular and elevation measurements, discuss recording methods and Instruments used. CO2 Calculate various parameters of linear, direction, angular measurement and Elevation of objects. CO3 Explain latest technologies and modern instruments used for surveying. CO4 Conduct experiments on linear, direction, angular and elevation measurements, Record and interpret the data.
19CV3PCMOF Mechanics of Fluids	CO1 Explain physical properties of a fluid and their applications in fluid mechanics.

	CO2 Apply concepts of total pressure and center of pressure to problems related to Fluid structure interactions. CO3 Identify fundamental kinematics of a fluid element. CO4 Apply concept of fluid measurement and pipe flows in Engineering problems.
19CV3PCSOM Strength of materials	CO1 Explain stress and strain at a point and their relations in a deformable material. CO2 Apply force equilibrium conditions and concept of free body diagrams to determine internal forces, stresses and responses under different loading conditions.
19HS3ICCIP Constitution of India and Professional Ethics	CO1 Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land. CO2 Analyze the concepts and ideas of Human Rights. CO3 Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
19HS3NCENV Environmental studies	CO1: Discuss the components and impacts of human activities on environment. CO2: Apply the environmental concepts for conservation and protection of natural resources. CO3: Identify and establish relationship between social, economic and ethical values from environmental perspectives.
4th Semester	
19CV4PCMATEngineering Mathematics-IV	CO 1 Demonstrate an understanding of concepts of statistical analysis and probability distributions. CO 2 Apply Numerical techniques to solve partial differential equations arising in engineering. CO 3 Demonstrate an understanding of analytic functions and their application to evaluate integrals.
1019CV4PCSTA Structural Analysis	CO1 Identify forms of structures and the associated indeterminacies CO2 Apply the force equilibrium conditions and compatibility conditions to analyze simple structures like arches, cables and evaluate structural response. CO3 Apply energy principles to analyze determinate structures.
19CV4PCCONConcrete Technology	CO1 Discuss the influence of the properties of ingredients of concrete including the marginal materials CO2 Explain the requirement of engineering properties of concrete for structural use CO3 Apply fundamental principles, procedures and various specifications for designing concrete mixes. CO4 Describe the causes of deterioration of concrete and the test methods CO5 Conduct experiments to determine the properties of concrete
19CV4PCGTEGeotechnical Engineering-I	CO1 Explain fundamental concepts and theory related to different phases of soil, Index properties, Engineering properties, and soil structure and soil water systems.

	CO2 Derive functional relationships, calculate Index properties, Engineering properties and Classify soils. CO3 Conduct experiments on soil, analyze, interpret the data, Comprehend and write reports.
19CV4PCHYMHydraulics and hydraulic machines	CO1 Analyze uniform & non uniform flows in open channels. CO2 Apply impulse momentum principle to compute impact of jet on fixed and moving plates CO3 Explain working of pumps and turbines and apply the basic principles to study the performance of these machines. CO4 Conduct experiments, interpret data and arrive at conclusions related to fluid mechanics, hydraulics and hydraulic machines.
19CV4PCWSEWater supply Engineering	CO1 Describe and design various parameters of collection and conveyance of water. CO2 Evaluate water quality parameters through water quality standards CO3 Describe basic structure of drinking water supply systems, conservation and design the component systems of water treatment facilities
19CV4PCBPDBuilding planning & drawing	CO1: Develop drawings from given line diagram. CO2: Prepare drawings of various components of buildings. CO3: Design and draw the various types of buildings as per requirements and develop drawings showing the interconnectivity of functional components of buildings along with service layouts.
5th Semester	
Indeterminate Structural Analysis (16CV5DCISA)	CO1: Develop relevant equations for Displacement method and applying the same for analysis on structures for different loading and boundary conditions. CO2: Develop conditions for Force method and applying the same for analysis on structures with different load and boundary conditions. CO3: Analyze beams for shear force and bending moment for rolling loads and use of Influence line diagrams.
Water Supply Engineering (16CV5DCWSE)	CO1:Describeand design various parameters of collectionandconveyance of water CO2: Evaluate water quality parameters through experiments CO3: Describe basic structure of drinking water supply systems and design the component systems of water treatment facilities
Foundation Engineering (16CV5DCFEN)	CO1: Compute consolidation and settlement characteristics of soil. CO2 : Determine lateral Earth pressure on retaining walls for its safe design CO3 : Analyze stability of soil slopes; and suggest slope protection measures CO4 : Suggest and plan various soil exploration techniques, and also estimate the state of stress below any type of loaded area

	CO5: Evaluate bearing capacity of soil to design a shallow foundation and Explain safety Measures and regulations for soil excavation. CO6: Perform experiments to evaluate various soil properties
Highway Engineering (16CV5DCHEN)	CO 1: Identify and Prioritize highway proposals for road development and decide the route alignment CO 2 Analyse and design the components of horizontal and vertical alignment of highways as per IRC specifications CO 3: Apply knowledge on properties of highway materials in conducting various laboratory tests and preparing reports CO 4 Analyse and design highway pavements and highway drainage CO 5 Select and analyze different materials required for road construction
Hydrology &Water Resources (16CV5DCHWR)	CO1: Describe hydrologic cycle and Analyse the rainfall data CO2: Compute the losses from precipitation. CO3: Estimate the runoff from a watershed CO4: Explain methods for measurement of stream flow and steady radial flow into wells
CadLab (16CV5DCCDL)	CO1: Prepare drawings of various components of a building. CO2: Prepare functional drawings for buildings as per norms.
Advance concrete technology 16CV5DEACT	CO1: Explain conventional concrete and their constituents CO2: Analyse different types of special concretes and mix design procedures
Alternativebuilding materials and technology 16CV5DEABM	CO1: Explain Energy concepts, environmental concerns for building materials and green building ratings CO2: Classify and explain alternate masonry units and various types of waste materials used for building construction CO3: Discuss properties, applications of fiber reinforced concrete and ferro cement CO4: Suggest cost effective design of buildings and describe different kinds of alternate roofing systems
Air pollution 16CV5DEAPL	CO1: Classify and analyze different types of air pollutants , explain their dispersion and effects on environment CO2: Analyze particulates control by different methods CO3: Explain air quality management, relevant standards and regulations CO4: Discuss causes, effects and control of noise pollution
Disaster management and mitigation 16CV5DEDMM	CO1: Differentiate types of disasters, its causes and identify vulnerable areas in India CO2: Suggest mitigation techniques during disaster CO3: Explain disaster management planning methods and execution of emergency management programme
Global warming and climate change 16CV5DEGWC	CO1: Describe causes and effects of green house gases CO2: Explain causes and impact of climate change and global measures taken CO3: Suggest mitigation techniques for climate change
6th Semester	
Design Of Steel Structures 16CV6DCDSS	CO1.: Knowledge of limit state design and its techniques. CO2: An ability to analyse and design structural steel joints.

	CO3 : An ability to analyse and design structural steel members subjected to flexure, tension and compression. CO4: An ability to understand the concepts of plastic analysis and use for the design of structural elements.
Design of RC Structures 16CV6DCDRC	CO1: Explain the fundamental principles and procedures in the component design of reinforced structures. CO2: Apply the principles of analysis of the Indian code design specification, the concepts of strain compatibility and equilibrium concepts to determine the strength of RC members. CO3: Design of simple RC components as per IS Codes.
Waste water Treatment 16CV6DCWWT	CO1: Describe strength of waste water and select appropriate treatment and disposal methods CO2: Explain the concepts of sewage systems and design sewers CO3: Describe and design various components of waste water treatment facilities
Extensive survey project 16CV6DCESP	Students are expected to prepare a detailed report giving the introduction, projects details and design
Software Applications lab 16CV6DCSWL	CO 1: An ability to understand Computational techniques related to civil engineering structural elements. CO 2: An ability to analyse and design RCC and steel structures using the software tools CO 3: An ability to model Civil Engineering structural elements using the software tools to understand their behavior
Theory of elasticity 16CV6DETOE	CO1: Explain the concepts of stress invariants and strains transformations, CO2: Discuss stress-strain relations and Torsion of Circular and non-circular sections
7th Semester	
Design & Drawing of RCC & Steel Structures 16CV7DCDDG	CO1: Design and prepare working drawings of RCC Structural components CO2: Design and prepare working drawings of Steel Structural components
Analysis and Design of Pre-stressed concrete members 16CV7DCPSC	CO 1: Comprehend pre-stressing and its techniques. CO 2: Evaluate the nature of stresses in the flexural member. CO 3: Design the flexural member.
Quantity Surveying & Costing 16CV7DCQSC	CO1: Estimate the material quantities of various Civil Engineering works CO2: Apply Cost Estimate CO3: Perform Rate analysis CO4: Write specifications for various items
Transportation Systems 16CV7DCTRS	CO1: Identify the components of permanent way and their required quantity of materials for construction. CO2: Design the geometrics of a Railway Track. CO3: Calculate the corrected runway length and taxiway geometrics. CO4: Recognise the fundamentals of Harbour and Tunnel Engineering.

	CO5: Explain the concepts of Traffic Engineering.
Major Project (Phase-1) 16CV7DCMAP	CO1: Identify a current problem through literature/field./case studies and define the background objectives and methodology for solving the same. CO2: Write report and present it effectively.
Remote Sensing & Geographical Information System 16CV7IERSG	CO1: Explain the principles of Geodatabase CO2: Discuss the application of multicriteria decision analysis for various issues. CO3: Recognize the various advances in GIS CO4: Outline the applications of enterprise and expert GIS
Finite Element Method of Analysis 16CV7IEFEA	CO1: APPLY basics of Theory of Elasticity to continuum problems. CO2: FORMULATE finite element like bar, truss and beam elements for linear static structural analysis. CO3: DEVELOP finite element models for 2D elements. CO4: COMPUTE Mass matrices for bar and beam elements. CO5: SOLVE problems of limited complexity in Linear static and Dynamics of structures. CO6 UTILIZE finite element software to simulate practical problems.
Advanced Design of RC Structures 16CV7DEADR	CO1: Analyze and design the components of water tank and curved beams CO2: Analyze and design the components of slabs and foundations.
Advanced Foundation Design 16CV7DEAFD	CO1: Classify and suggest foundation type for various field and loading conditions, understand the basic requirements of a satisfactory foundation and the determinants of foundation location and depth, and proportion shallow foundations. CO2: Estimate individual vertical and lateral pile load capacity, pile group capacity, and pile group efficiency. CO3: Explain the causes of expansive nature of clays, simple methods to assess the swelling potential and methods to prevent and overcome swelling of expansive clays
Geometric Design of Roads 16CV7DEGDR	CO1: select appropriate cross sectional elements of a roads CO2: Analyse the horizontal alignment of a roads CO3: Analyse the vertical alignment of a roads CO4: Design various types of intersections of a roads
Ground Water Hydrology 16CV7DEGHY	CO1: Explain the fundamental concepts of the occurrence and movement of groundwater CO2: Estimate the ground water flow rate and flow direction using modeling techniques CO3: Estimate the yield from a well and analyse the performance of a recharge well CO4: Analyse the movement of pollutants in groundwater and explain the freshwater and groundwater interface CO5: Explain various surface and subsurface groundwater investigation methods
Industrial Waste Water Treatment 16CV7DEIWW	CO1: Describe the effects of industrial waste water on streams and treatment plants.

	CO2: Explain the process of natural purification of streams and various pre-treatment methods. CO3: Recognize sources, characteristics and treatment methods of industrial waste water.
Design and drawing of Bridges and Irrigation Structures 16CV7DEDDB	CO1: Design and Draw different types of bridges. CO2: Design and draw major hydraulic structures.
Structural Dynamics 16CV7DESDY	CO1: Compute natural frequency and free vibration response of SDOF systems CO2: Set-up the equation of motion and obtain the Dynamic magnification factor of SDOF systems subjected to harmonic inputs CO3: Set-up equation of motion of free-vibration response of MDOF systems and continuous systems, solve them to obtain natural frequencies (Eigen values) and mode shapes (Eigen vectors) CO4: Conduct free vibration tests to obtain natural frequency and damping
8th Semester	
Construction Project management, finance and professional ethics 16CV8 HS CMF	CO1: Demonstrate the knowledge of organization structure of a project and apply Scheduling techniques for managing construction projects. CO2: Apply the concept of time value of money to different real time situations. CO3: Analyse different economic feasible alternatives using present worth/rate of return methods of investment. CO4: Examine the economics of a project and appraise financial statements CO5: Apply professional ethics in engineering practice through case studies.
Major Project (Phase-2) 16CV8DCMAP	CO1: Identify a current problem through literature/field./case studies and define the background objectives and methodology for solving the same. CO2: Analyse, design and develop a technology/process CO3: Implement and evaluate the technology at the laboratory level CO4: Write report and present it effectively.
Internship/Industrial Training 16CV8DCITP	All the students are encouraged to undergo a minimum of 4 weeks industrial training in an ongoing construction project and submit a report consisting the details of the organization, project details and specific construction aspect which they have learnt during that period for CIE to be recognized as an audit course.
Occupational Safety and Health Administration 16CV8IEOSH	CO1 : Demonstrate the knowledge of principles of safety and Legislation CO2: Explain accident Investigation and Reporting CO3: Recognize the various hazards and Risk analysis CO4: Illustrate the various Occupational health and Toxicology issues.

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Earthquake Resistant Design of Structures 16CV8DEERD	CO1: Describe the fundamentals of engineering seismology CO2: Characterize the Earthquake ground motions and prepare the basis for estimation of seismic forces CO3: Analyse , design and detail , buildings for seismic resistance through concepts of ductility as per BIS codes CO4: Identify and comprehend failure patterns of buildings during earthquake
Environmental Impact Assessment 16CV8DEEIA	CO1: Explain the major principles and mechanisms of Environmental Impact Assessment. CO2: Describe the different stages of Environmental Impact Assessment in India. CO3: Illustrate the process of issues concerning societal, ethical and legislative needs.
Geotechnical Earthquake Engineering 16CV8DEGEE	CO1: Explain the basic concepts of earthquake, its causes, evaluation and mitigation. CO2:Identify dynamic soil properties and Compute factor of safety against liquefaction CO3:Design earthquake resistant shallow foundations and retaining walls
Integrated Watershed Management 16CV8DEIWM	CO1:Explain the fundamental concepts of watershed behavior and watershed management and explain the application of modern techniques in watershed management CO2: Apply different models to estimate runoff and soil erosion from a watershed CO3: Identify the types and sources of water pollution CO4: Apply various methods to assess / model flood and drought
Reinforced Earth Structures 16CV8DERES	CO1: Explain the basic concepts and components of Reinforced Earth constructions. CO2: Classify geosynthetic materials, and outline their properties CO3: Design Reinforced Retaining walls and pavements; summarize various applications of geosynthetics in civil Engineering
Urban Transport Planning 16CV8DEUTP	CO1: Outline the types of surveys to provide the data required for transportation planning CO2:Develop trip production models & compute trip attraction rates CO3: Develop various trip distribution models & calibrate using gravity model CO4: Build aggregate mode split models & analyse transportation network flows CO5: Discuss characteristics of mass transit systems

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Name of the Programme	**M.Tech in Construction Technology**
Programme Educational Objectives (PEOs)	PEO1: Able to pursue professional career in the constantly changing field of construction, Engineering, Technology and Management. PEO2: Able to contribute to knowledge base through teaching and research. PEO3: Able to practice and promote sustainable construction technologies for social needs.
Programme Outcomes (POs)	PO1: An ability to independently carry out research /investigation and development work to solve practical problems PO2: An ability to write and present a substantial technical report/document PO3: An ability to demonstrate mastery in the domain of the specialization of the program
Course Names	**Course Outcomes (COs)**
18CVCTPCMC MECHANIZATION IN CONSTRUCTION	CO1: Comprehend and present the extent of mechanization in construction activities of regular and landmark structures CO2: Write and compare conventional and modern construction technologies
18CVCTPCPM CONSTRUCTION PROJECT MANAGEMENT	CO1: Identify the organization structure of a project, provide an outline of project planning by drawing network diagram using CPM and PERT analysis CO2: Develop resource plan, resource allocation and resource leveling for a construction project including estimation of time-cost trade–off in a construction project and to work in a team to develop construction schedules for real time projects
18CVCTPCCT ADVANCES IN CONCRETE TECHNOLOGY	CO1: Identify constituent of concrete material characteristics and different types of concrete for their appropriate use in construction CO2: Distinguish concrete behavior based on its fresh and hardened properties and distinguish concrete behavior based on its fresh and hardened properties. CO3: Prepare a comprehensive report on new knowledge in any one of the topic related to concrete technology and evaluation of concrete mix designed for a specific construction project.
18CVCTPCAS APPLIED STATISTICS AND OPTIMIZATION TECHNIQUES	CO1: Use appropriate statistical decision making testing tools in the data analysis. CO2: Apply the optimization techniques in construction
16APRDICRM RESEARCH METHODOLOGY	CO1: Define the research problem, identify objectives and develop a methodology for the research problem CO2: Interpret the literature, analyse the findings of research and technical reports and thesis

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18CVCTPCEF CONSTRUCTION ECONOMICS AND FINANCE	CO1: Apply the concept of time value of money to different real time situations CO2: Analyse different economic feasible alternatives using present worth/rate of return methods of investment and demonstrate construction accounting principles to prepare financial statements. CO3: Appraise financial health of construction organizations using financial evaluation tools and develop a comprehensive investment proposal on any construction enterprise
18CVCTPCSC SUSTAINABLE CONSTRUCTION	CO1: Identify principles of sustainability, assess sustainability through rating systems and carry out life cycle analysis of a typical building CO2: Develop recycling process, characterize marginal materials and evaluate recycled products
18CVCTPCSM STRUCTURAL MASONRY	CO1: Characterize and evaluate the strength of masonry materials CO2: Design masonry elements under different loads
18CVCTPERC ADVANCED REINFORCED CONCRETE DESIGN	CO1: Identify the behavior of components of complex RC structures and apply the concepts to design them. CO2: Analyse and design components of complex RC structures as per BIS code and generate the reinforcement detailing of the designed RC structures.
18CVCTOEQS CONSTRUCTION QUALITY AND SAFETY	CO1: Outline the importance of Quality and Safety and explain the various Quality assessing tools as applied to construction industry. CO2: Understand the importance and need of a safety division and its role in construction projects and examine ACT 1996, BIS Safety standards and rules.
18CVCTPEDS ADVANCED DESIGN OF SUB STRUCTURES	CO1: Classify and suggest foundation type for various field and loading conditions, understand the basic requirements of a satisfactory foundation and the determinants of foundation location and depth, and proportion shallow foundations CO2: Estimate individual vertical pile load capacity, pile group capacity, and pile group efficiency and comprehend the application and requirements of other types of deep foundations namely drilled piers, caissons and well foundations. CO3: Develop an understanding of the various structural features, assessing the forces, design criteria and choice of foundation for a port structure and transmission line tower.
18CVCTPEBS BUILDING SCIENCE	CO1: Interpret the physical phenomenon of weather on buildings CO2: Identify and analyse materials suitable for optimal environmental performance on buildings and design integrated systems to optimize building performance
18CVCTPEPT PRE ENGINEERED CONSTRUCTION TECHNOLOGY	CO1: Investigate Pre-Engineered building technology and plan simple buildings using various types of prefabricated elements CO2: Design and outline production of precast elements

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18CVCTPEPD PAVEMENT DESIGN AND CONSTRUCTION	CO1: Analyse the difference between the design principles of flexible and rigid pavements including evaluation of stresses from loads from vehicles, EWL concepts and layered system concepts. CO2: Prepare flexible pavement design based on laboratory and theoretical methods as per IRC guidelines. CO3: Prepare rigid pavement design based on laboratory and theoretical methods as per IRC guidelines. CO4: Learn the various equipment to be used for road construction including some special equipment's. CO5: Understand the construction procedure principles for various layers of flexible pavement like earthwork, GSB, Base course and surface course including specification and quality control tests. CO6: Understand the construction procedure principles for various layers of rigid pavement like laying of pavement quality concrete including specification and quality control tests.
18CVCTPEPC PRE-STRESSED CONCRETE	CO1: Evaluate the internal stresses of a PSC element, estimate the resultant stress at any section, generate the pressure line and evaluate the losses in PSC members to determine the effective prestressing force. CO2: Analyse design PSC members for flexure shear and torsion, evaluate anchorage zone stresses and design the anchorage zones
18CVCTPESM BUILDING SERVICES AND MAINTENANCE	CO1: Apply fire/MEP systems to any given building systems as per NBC standards. CO2: Identity causes of deterioration and plan maintenance schedule for building systems
18CVCTPEGT SOIL EXPLORATION AND GROUND IMPROVEMENT TECHNIQUES	CO1: Identify and prioritize different methods of boring and sampling techniques for soil exploration with Laboratory and field testing of soil exploration samples and prepare the test reports to evaluate the economics of soil exploration. CO2: Implement different methods of soil improvement techniques, analyse different case histories of soil exploration methods and ground improvement techniques.
18CVCTPERE REMEDIAL ENGINEERING	CO1: Identify the various causes of deterioration of structures and relate it to the effects and choose the diagnostic methods and tools after identifying the levels of distress in structures. CO2: Formulate a strategy for repair and rehabilitation by selecting appropriate repair materials and techniques and infer the results of a case study and provide techniques for repair.
18CVCTPEER DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	CO1: Describe the fundamentals of engineering seismology, characterize the earthquake ground motions and prepare the basis for estimations of seismic forces. CO2: Analysis, design and detailing the building components for seismic resistance as per BIS codal provisions, identify and discuss the failure patterns of building during earthquake.

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18CVCTPECC CONSTRUCTION AND CONTRACT MANAGEMENT	CO1: Prepare the project cost estimate and compose the tender / contract documents. CO2: Identify the appropriate types of contract for a given construction project and interpret claim records to solve arbitration cases.
18CVCTPJP1 MAJOR PROJECT (PHASE - I)	CO1: Exhibit application of knowledge, critical thinking and formulate problem in the field of construction materials/ technology and demonstrate skills on research literature. CO2: Demonstrate skills in developing research methodologies and designing and conduction of experiments.
18CVCTPCIT INDUSTRIAL TRAINING	CO1: Comprehend construction company organizational/financial structure and demonstrate professional skills relevant to construction technology. CO2: Apply and correlate theory and practice and to communicate effectively regarding complex Engineering activities and engage in life-long learning by observing and examining critically and make corrections cautiously.
18CVCTPJP2 MAJOR PROJECT (PHASE–2) (DISSERTATION AND VIVA-VOCE)	CO1: Analyse and interpret the analytical and experimental data effectively. CO2: Communicate confidently and comprehend and write reports effectively.
Name of the Programme	**MTech in Environmental Engineering**
PEOs	PEO1: Possess the knowledge, attitude and skills needed for a professional career in the field of Environmental engineering and Management. PEO2: Continue to advance career through higher education and professional development. PEO3: Advocate environmental engineering for societal issues and sustainable development of society.
Programme Outcomes (POs)	PO1-An ability to independently carry out research/investigation and development work to solve practical problems. PO2-An ability to write and present a substantial technical report/document PO3-Students should be able to demonstrate a degree of mastery over the area as per the specialization of the programs. The mastery should be at a level higher than the requirements in the appropriate bachelor programme.
Course Outcomes (COs)	Do not attach the scheme please. Only COs for each course is required and not the entire syllabus. The COs for all the courses offered - Core and electives needs to be given.
18CVENPCCM Applied Environmental Chemistry And Microbiology	CO1: Explain concepts behind principles of Physical, Colloidal, analytical chemistry, Electrochemistry and microbiology in Environmental engineering processes. CO2: Apply the principles of Physical, Electrochemistry and Analytical chemistry in Environmental Engineering process.

	CO3: Conduct experiments to evaluate water quality parameters.
18CVENPCWT Water Treatment Technology	CO1: Select the sources of water for various water uses and explain unit operations and processes of water treatment systems. CO2: Apply the principles and design water treatment units.
18CVENPCAC Atmospheric Environmental Pollution And Control	CO1: Identify and explain sources, characterization of pollutants and their effects on outdoor and indoor atmosphere, plume behavior, monitoring of pollutants. CO2: Develop governing equations for lapse rate, prediction of pollution concentration in atmosphere (Gaussian, Area model), and effective stock height and solve problem MMD, wind rose and concentration prediction, Controlling of particulate and gaseous pollutants. CO3: Collect field data, historical data for investigation and analysis of air and noise quality, prepare report.
18CVENPEWR Water Resources Engineering And Applied Hydraulics	CO1: Estimate rainfall, optimum rain gauges and consistency with the concept hydrology, Analysis of hydrograph, low and high flows, Estimate discharge in rivers, streams and overland peak flows, design of storm drains and outfall sewer. CO2: Apply the concepts of hydraulics to design water mains, steady state groundwater problems. CO3: Collect field data, historical data for investigation and analysis of trend, average quantities
18CVENPELP Environmental Legal Aspects And Policy Guidelines	CO1: Outline the various acts, rules and regulations of environment protection. CO2: Explain the role of the Central and state judiciaries, as well as state legislatures and agencies, in formulating and implementing environmental policy.
18CVENPEGC Global Warming And Climate Change	CO1: Identify the various issues pertaining to climate change, Outline the various impacts of climate change globally and on regional scale. CO2: Explain cleaner technologies and carbon sequestration to check global warming.
18CVENPESH Solid and Hazardous Waste Management	CO1: Understand and apply the basic scientific and sustainability principles behind waste management, for solving practical waste management challenges CO2: Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste CO3: Make an effective oral presentation on recent trends of solid and hazardous waste management through extensive literature.
18CVENPEEG Environmental Geo-Technology	CO1: Identify the causes for soil pollution and behavior of the pollutants. CO2: Evaluate and remediate contaminated sites and monitor to bring natural attenuation

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18CVENPERF Renewable Energy And Alternative Fuels	CO1: Outline the need and application of various alternative fuels, : Explain various methods/technologies to harness various renewable energy sources, : Explain various methods/technologies to harness various renewable energy sources
18ALLPICRM Research Methodology and IPR	CO1 Ability to write and present a substantial technical report/document CO2 Able to demonstrate a degree of mastery over the area of specialization
18CVENPCWW Wastewater Treatment Engineering	CO1: Explain the unit operations and processes for wastewater treatment. CO2: Apply the principles and design unit operations and processes for wastewater treatment. CO3: Conduct experiments to evaluate wastewater quality parameters
18CVENPCRG Remote Sensing and GIS In Environmental Engineering	CO1: Explain the basic principles of remote sensing, Outline the importance and concept of image processing CO2: Explain the basic principles and components of GIS, Apply the knowledge of RS-GIS for various environmental problems CO3: conduct activities on basics in remote sensing and GIS
18CVENPCSC Statistics and computational methods	CO1: Apply statistical techniques to examine data. CO2: Solve engineering problems that involve constrained resource allocation. CO3: Solve the governing equations of partial differential in nature applied to engineering problems.
18CVENPEEA Ecology And Environmental Impact Assessment	CO1: Identify different Components of ecosystem and their interactions and interrelationships. CO2: Outline the systematic process for environmental impact assessment along with different methodologies. CO3: Identify and assess the impacts on environmental attributes from developmental projects, Explain importance of Public participation, EMP and DMP in EIA process.
18CVENPETA Toxicology & Environmental Risk Assessment	CO1: Outline the methods and processes employed in environmental health and risk assessment, explain the key principles of environmental health risk characterization CO2: Identify risk due to carcinogens and analyze various methods of risk assessment.
18CVENPENM Non – Point Sources Of Pollution And Management	CO1: Utilize Simulation Models for tracing nonpoint source pollution. CO2: Develop management solutions for nonpoint source pollution control, Select best management solutions for nonpoint source pollution control.
18CVENPEEM Environmental Planning And Management	CO1: Outline issues related to environmental planning and sustainable development. CO2: Identify various economic tools in evaluation of environmental aspects, Apply quality management principles in Environmental Auditing.

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18CVENPEIW Industrial Wastewater Treatment	CO1: Outline the effects of industrial wastes on the treatment plants, water bodies, soil and explain surveying of industrial waste for pretreatment programme. CO2: Explain wastewater treatment in specific industries and design treatment units.
18CVENPESA Waste To Energy	CO1: Understand the different wastes as fuel and conversion devices to convert waste to energy. CO2: Understand the existing technologies for the treatment of biomass and design the devices CO3: Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.
18CVENOESA Occupational Safety And Health Administration	CO1: Outline the issues related to health and safety through various Acts, Identify health problems in different types of industries CO2: Apply types of accident causation models and Hazard Analysis. CO3: Identify different classes of fire with suitable fire extinguishing system.
18CVENPETM Transport Processes And Modeling Of Aquatic Systems	CO1: Identify importance and basics of Modelling; different types of outlets, characteristics of zones, ocean disposal and guide lines, single port and multiport system. CO2: Develop governing equations for transport of conservative and non-conservative contaminant in a aquatic system DO models, phosphorous model, fate transport through ground water. CO3: Predict and investigate contaminant extent in aquatic systems.
18CVENPEOM Operation & Maintenance Of Environmental Facilities	CO1: Know the need, types, basic principles, organizational structure, work planning and scheduling and cost estimates of O&M and explain the importance of drawings, plans, record keeping, need for operational manual and SOP. CO2: Identify and list the operational problems in water treatment and supply facilities, wastewater collection and treatment facilities and apply preventive and corrective maintenance measures CO3 Identify and discuss the troubles in air pollution control systems and suggest the preventive and control measures
18CVENPEEB Environmental Biotechnology	CO1: Understand and explain the methods and techniques for analysis of environmental samples CO2: Apply the technologies for bioremediation of soil, water and air.
18CVENPWP2 Major Project	CO 1: Identify a current problem through literature/field/case studies and define the background objectives and methodology for solving the same. CO 2: Design and develop a technology/process to address the problem

	CO3: Implement, analyze and evaluate the technology/process developed. CO4: Demonstrate writing and communication skills effectively
18CVENPWP1 MajorProject–Phase-I, 18CVENPCIN Internship/Industrial training	CO 1: Comprehend the organization structure and management processes involved in the organization. CO 2: Explain the state of the art technologies / processes/ materials implemented in the organization. CO 3: Demonstrate writing and Communication skills effectively.
18CVENPCSR Seminar	CO1: Collect, assimilate, analyze and interpret the technical information/data pertaining to the recent environmental engineering related topics through literature survey. CO 2: Demonstrate writing and Communication skills effectively.
18CVENNCDM Disaster Management	CO1: learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. CO2: critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. CO3: develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. CO4 critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.
18CVENNCPS Pedagogy Studies	CO1: Understand what pedagogical practices are being used by teachers in formal and informal classrooms in developing countries? CO2: understand what is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners? CO3: understand how can teacher education (curriculum and practicum) and the school curriculum and guidance Materials best support effective pedagogy?
18CVENNCVE Value Education	CO1: Knowledge of self-development CO2: Learn the importance of Human values CO3: Developing the overall personality
18CVENNCEW English for Research Paper Writing	CO1: Write paragraphs avoiding ambiguity and vagueness CO2: Understand the key skills are needed when writing a Title, Abstract, Introduction, and Review of the Literature, Methods, Results and Discussion with Conclusions.
Name of the Programme	**M.Tech in Transportation Engineering**
PEOs	PEO1: Reveal essential knowledge and skills necessary for a professional career in Transportation Engineering and management. PEO2: Demonstrate the analytical, quantitative and interpretative abilities required for the effective leadership in their chosen field. PEO3: Exhibit the responsibility in a professional and ethical manner in their domain and continue

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	career through lifelong learning to contribute to the societal needs.
Programme Outcomes (POs)	PO1: An ability to independently carry out research /investigation and development work to solve practical problemsPO2: An ability to write and present a substantial technical report/documentPO3: An ability to demonstrate mastery in the domain of the specialization of the program
Course Name	Course Outcomes (Cos)
18CVTEPCTE TRAFFIC ENGINEERING	• Acquire and apply knowledge of traffic, its components, and factors affecting road traffic in design. • Apply the knowledge of sampling data in conducting various surveys and analysis. • Interpretation of various survey data analysis and their applications in traffic engineering. • Design new traffic signals & redesign of existing signals and importance of ITS. • Understand micro level analysis of traffic flow.
18CVTEBSAS APPLIED STATISTICS & PROBABILITY	• Able to use appropriate statistical method in transportation engineering problems. • Capable of applying the rule of probability and discrete distributions in solving problems. • Capable of testing the goodness of fit by using statistical decision. • Able to apply the knowledge of optimization technique and use statistical software in analysis of transportation engineering problems.
18CVTEPCPM PAVEMENT MATERIALS & CONSTRUCTION	• Able to acquire and apply knowledge of properties of road aggregates and binders in conducting various laboratory tests. • Qualified to design bituminous mix with Rothfutch method considering the required specifications. • Understand the application of various equipment used for road construction • Able to understand Technology and the construction process of Bituminous and Cement-Concrete roads
18CVTEPEAM APPLIED SOIL MECHANICS	• To gain knowledge about assessing suitability of soil as a subgrade or as a material for construction of roads and embankments.
18CVTEPETS TRANSPORTATION STRUCTURES	• Decide the selection of transportation structures, list the factors affecting design of various transportation structures and generate the input parameters required for design. • Summarize the design methodology and arrive at design values for various transportation structures.
18CVTEPEUT URBAN PUBLIC TRANSPORT	• Able to remember transit modes, management activities and demand analysis.

	• Capable of selecting different demand management techniques, intersection management techniques and small area management.
18CVTEPETP TRANSPORT PLANNING	• Estimate travel demand for urban settlements • Prepare demand distribution models (gravity models) and modal split models for mode choice analysis. • Develop and calibrate trip generation rates for specific types of land use developments.
18CVTEPETY TRANSPORTATION SYSTEMS	• To list the various surveys required for traffic management • To identify transportation problem at a given site, analyse the survey data and synthesize efficient traffic management measures
18CVTEPEOT OPTIMIZATION TECHNIQUES	• Use effectively the different optimization techniques and apply to the appropriate engineering problems. • Encounter, study and solve optimization problems.
18CVTEPLAP ADVANCED PAVEMENT MATERIALS LABORATORY	• Able to test the aggregates and bitumen for different properties • Qualified to design bituminous mix Rothfutch method of marshal mix design • Able to analyze the properties of cement and do concrete mix design.
18CVTEPCAD ANALYSIS AND DESIGN OF PAVEMENTS	• List and explain the various factors affecting design and performance of pavements. • Design flexible and rigid pavements. • Understand importance and design concepts of providing Rural Roads
18CVTEPCPE PAVEMENT EVALUATION AND MANAGEMENT	• Identify the factors influencing performance of pavements • Carry out structural and functional evaluation of pavements • Explain the use of models for pavement management • Develop a framework for efficient pavement management system
18CVTEPCTF THEORIES OF TRAFFIC FLOW	• Able to apply the flow theories to field situations such as toll booths, diversion measures etc. • Able to understand various car following theories • Able to apply the concepts of vehicle arrivals to field situations such as exit ramps, entry ramps etc by queuing theory • Able to appreciate the application of GIS techniques in traffic engineering.
18CVTEPERS ROAD SAFETY AND MANAGEMENT	• Able to acquire knowledge statistical methods and computer application of accident analysis. • Able to remember the process of road safety audit and the measures of improving road safety.

	• Qualified to evaluate the effectiveness of various management techniques adopted in reducing road accident.
18CVTEPEIT INTELLIGENT TRANSPORTATION SYSTEMS	• Able to appreciate the advantages of ITS and suggest the appropriate technologies for field conditions. • Able to suggest the appropriate system/s in various functional areas of transportation. • Able to amalgamate the various systems, plan and implement the applications of ITS.
18CVTEPETR TRANSPORT ECONOMICS	• Able to apply the concepts and tools of microeconomics. • Able to understand basic concepts of economic analysis. • Understand Economic theory as applied to transport, including demand, supply and pricing theory and practice.
18CVTEPEGD GEOMETRIC DESIGN OF TRANSPORTATION FACILITIES	• Able to design the cross sectional elements of different classes of highways. • Able to design the components of horizontal and vertical alignment of different classes of highways. • Able to appreciate the various types of intersections and suggest the required measures.
18CVTEPEMM TRANSPORTATION MODELING AND MANAGEMENT	• Able to have the knowledge in system Dynamics of simulation • Able to generate Transportation Models
18CVTEPJP1 Major Project (Dissertation) 18CVTEPLTC TRANSPORTATION ENGG. COMPUTATION LABORATORY 18CVTEPCTS Transport System Analysis	• Show skills in developing research procedures and planning of experiments • Study and infer the analytical and experimental data effectively. • Communicate effectively, apprehend and write reports efficiently.
18CVTENIIT Internship (8 Weeks) 18CVTEPJP2 Project – Phase II	• Know Transportation Engineering Agency's Administrative structure. • Exhibit professional abilities pertinent to Transportation Engineering. • Apply and correlate theory and practice and to communicate effectively regarding complex Engineering activities. • Engage in life-long learning by observing and examining critically and make corrections cautiously.

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Academic Year 2019-20

<table>
<tr><td>Name of the Programme</td><td>B.E. in Mechanical Engineering</td></tr>
<tr><td>Program Educational Objectives (PEO's)</td><td>• PEO1 - Graduates shall have successful careers as Mechanical Engineers, lead & manage teams.
• PEO2 - Graduates shall be professional in engineering practice and socially responsible
• PEO3- Graduates shall be pursuing advanced education, research and engage in the process of life-long learning.</td></tr>
<tr><td>Programme Specific Outcomes (PSOs)</td><td>• Design mechanical engineering systems using classical and state-of-the-art tools.
• Apply principles of energy conversion in design and development of thermal systems.
• Identify and select appropriate manufacturing processes, tooling, machinery and apply quality control methods for production of various components and systems</td></tr>
<tr><td>Programme Outcomes (POs)</td><td>PO1 to PO12
<table>
<tr><th>PO Number</th><th>Program Outcome</th><th>Graduate attribute (GA)</th></tr>
<tr><td>PO1</td><td>Ability to apply knowledge of mathematics, science, and Mechanical engineering fundamentals to solve complex problems in engineering</td><td>Apply Engineering Knowledge</td></tr>
<tr><td>PO2</td><td>Ability to analyze mechanical engineering problems, interpret data and arrive at meaningful conclusions involving mathematical inferences</td><td>Problem Analysis</td></tr>
<tr><td>PO3</td><td>Ability to design a mechanical system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations</td><td>Design / Development of solutions</td></tr>
<tr><td>PO4</td><td>Ability to understand and solve complex mechanical engineering problems by conducting experimental investigations.</td><td>Conduct Investigations of Complex problems</td></tr>
<tr><td>PO5</td><td>Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex mechanical engineering activities.</td><td>Modern Tool usage</td></tr>
<tr><td>PO6</td><td>Ability to understand the effect of mechanical engineering solutions on legal, cultural, social and public health and safety aspects.</td><td>Engineer and the Society</td></tr>
</table></td></tr>
</table>

	PO7	Ability to develop sustainable solutions and understand their effect on society and environment.	Environment and Sustainability
	PO8	Ability to apply ethical principles to engineering practices and professional responsibilities.	Ethics
	PO9	Ability to work as a member of a team, to plan and to integrate knowledge of various engineering disciplines and to lead teams in multidisciplinary settings.	Individual and Team Work
	PO10	Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means	Communication
	PO11	Ability to lead and manage multidisciplinary teams by applying engineering and management principles.	Project management and Finance
	PO12	Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning	Life-long learning
	The COs for all the courses offered - Core and electives		
Course Name & Code	Course Outcomes		
Engineering Mathematics – 3 19MA3BS EM3	CO1 : Compute solution of a system of algebraic equations CO2 : Demonstrate an understanding to Fourier series and Fourier transforms. CO3 : Demonstrate an understanding to Fourier transforms CO4 : Employ analytical techniques to solve partial differential equations with appropriate boundary conditions CO5 : Obtain the extremal of a functional.		
Material Science and Metallurgy 19ME3DC MSM	CO1 : Select appropriate materials based on applications through the knowledge of micro-structure and properties of metals & composites CO2 : Compute phase change parameters in isomorphous & eutectic systems CO3 : Identify appropriate transformation process to obtain required material properties CO4 : Choose appropriate heat-treatment process fulfilling given criteria CO5 : Determine the Mechanical properties of materials and Micro structure by conducting experimental investigations.		
Fluid Mechanics	CO1 : Apply the concepts of fluid mechanics, pressure distribution and buoyancy to determine the static forces of the fluids CO2 : Analyse external & internal flows for evaluating various flow-		

19ME3DC FME	parameters CO3 : Perform dimensional analysis to formulate mathematic model.
Manufacturing Processes 19ME3DC MAP	CO1 : Classify primary manufacturing processes, such as casting, welding, powder metallurgy and Rapid Prototyping CO2 : Analyze and select suitable sand ingredients, gating system, mould and calculate the dimensions on sand mold CO3 : Assess the defects in casting and welding by analyzing the microstructure CO4 : Identify real time applications of special casting process, Powder Metallurgy, welding and Rapid Prototyping in industries. CO5 : Select different processes of Rapid prototyping for given applications used in various industries CO6 : Design the sand mould as per given drawing CO7 : Demonstrate the process of mould making
Strength of Materials 19ME3DC SOM	CO1 : Compare and choose appropriate materials for given applications CO2 : Investigate various structural members subjected to different loading conditions for determination of stresses & strains CO3 : Evaluate mechanical properties of cylindrical shafts subjected to torsional loads. CO4 : Analyse cylindrical pressure vessels under various loadings
Computer Aided Machine Drawing 19ME3DC CMD	CO1 : Choose appropriate views to give information about machine parts CO2 : Apply drawing conventions to communicate design intent unambiguously CO3 : Sketch sectional views to reveal interior features of machine parts to enhance clarity. CO4 : Identify relationships of each part to the others in assemblies CO5 : Construct assembly drawings showing all parts in their operational positions CO6 : Create geometric models of mechanical parts and assemblies employing CAD tool.
Basic Thermodynamics 19ME3DC BTD	CO1 : Apply the energy balance to thermodynamic systems involving heat and work interactions to determine thermodynamic properties. CO2 : Evaluate the performance of energy conversion devices undergoing a thermodynamic process or cycle and entropy of system. CO3 : Analyze a thermodynamic system for Availability & Irreversibility CO4 : Estimate the properties of systems employing ideal and real gases as working fluids
Higher Engineering Mathematics 19MA4BS HEM	CO1 : Calculate numerical solutions of algebraic equations, transcendental equations and ordinary differential equations CO2 : Construct analytic functions and evaluate real and complex integrals CO3 : Apply the principles of least squares to fit a straight line, parabolic and exponential curve for a given data. CO4 : Estimate the relation between two variables and perform

	regression analysis CO5 : Apply the basic principles of probability and probability distributions CO6 : Obtain the probability of an event using discrete and continuous distributions, including then-step transition probability. Analyse and classify simples states (Recurrent/transient)
Manufacturing Technology 19ME4DC MFT	CO1 : Analyze various cutting parameters in metal cutting CO2 : Understand the construction of machines & machine tools and compute the machining time of various operations CO3 : Understand the concept of metal forming processes, types and applications CO4 : Apply the knowledge of metal forming processes for production of engineering parts CO5 : Create components using machine tools
Design of Machine Elements – 1 19ME4DC DM1	CO1 : Apply concepts of mechanics of materials to estimate the stresses in a machine element and predict failure of components based on theories of failure CO2 : Analyse the effect of fatigue load on machine elements and factors affecting it to predict failure. CO3 : Design machine elements such as Shafts, Keys, Cotter joints, Structural joints, Fasteners and Power screws.
Kinematics of Machines 19ME4DC KOM	CO1 : Apply knowledge of fundamentals of kinematics to common mechanisms and determine kinematic-parameters of mechanisms. CO2 : Estimate various profile-parameters in gears CO3 : Analyze the performance of gear trains for power transmission. CO4 : Synthesize cam profiles for different applications CO5 : Use modern-tools to simulate simple mechanisms.
Mechanical Measurements and Metrology 19ME4DC MMM	CO1 : Estimate errors during calibration of measuring instruments CO2 : Select the system of limits, fits, tolerances and gauging, various measuring instruments for measuring mechanical quantities CO3 : Design various types of fits and tolerances of shafts and holes CO4 : Build Measurement circuits for various measurement scenarios CO5 : Compare the measurement processes and devices in engineering applications CO6 : Demonstrate calibration of various physical parameters and phenomena
Applied Thermodynamics 19ME4DC ATD	CO1 : Apply the first and second laws of thermodynamics in the analysis of energy components to determine the properties pertaining to thermodynamic-cycles CO2 : Analyze the thermodynamic-cycles of internal combustion engines in order to evaluate its performance CO3 : Assess benefits of improvements to thermodynamic systems CO4 : Investigate the performance of thermodynamic systems for their performance CO5 : Synthesise & interpret the experimental data of thermal systems
Numerical	CO1 : Apply algorithmic problem-solving skills CO2 : Create functions, scripts, programs which solve medium

Applications for Mechanical Engineering Lab 19ME4DL NAM	complex engineering tasks CO3 : Develop solutions to mathematical models applied to practical Mechanical engineering problems. CO4 : Utilize MATLAB software to simulate practical problems
Modelling & Finite Element Analysis 16ME6DCMFE	CO 1 Apply basics of Theory of Elasticity to continuum problems.
	CO 2 Formulate finite elements like bar, truss and beam elements for linear static structural analysis.
	CO 3 Develop models for 2D and axisymmetric finite elements and 1D heat transfer
	CO 4 Solve problems of limited complexity in structural and heat transfer domain
	CO 5 Utilize finite element software to simulate practical problems.
	CO 6 Identify the degree of freedom of elements to be modeled and boundary conditions to be incorporated.
Metal Forming 16ME6DCMTF	CO 1 Identify the various metal working processes, based on process parameters.
	CO 2 Discover the various process capabilities to establish the relation between them.
	CO 3 Solve relevant real world problems concerning Rolling, drawing and extrusion of metals.
	CO 4 Formulate mathematical equations for Rolling, drawing and extrusion of metals
	CO 5 Choose the appropriate die for the various functions of sheet metal working process
	CO 6 Categorize the different non-traditional forming processes.
Turbo Machines 16ME6DCTUM	CO 1 Classify typical designs of turbo machines.
	CO 2 Compare homologous machines by using dimensional analysis.
	CO 3 Apply Euler's equation for turbomachinery to analyze energy transfer in turbines and compressors.
	CO 4 Evaluate the performance parameters of pumps, compressors, turbines on a 1-D basis with the use of velocity triangles
	CO 5 Make use of laboratory equipment's for conducting experiments.
	CO 6 Estimate the data in design and development of Turbomachines.
Fundamental of Robotics 16ME6DEROB	
	CO 1 Develop representation of robots in workspace.
	CO 2 Solve for kinematics of robot manipulators
	CO 3 Plan trajectory for robot motion
	CO 4 Select actuators, sensors and controllers for robotic applications

	CO 5 Design simple robots
	CO 6 Build simple robots
Production & Operation Management 16ME6DEPOM	
	CO 1 Plan to use Operations Management And Strategies for managing operations
	CO 2 Identify suitable evaluation methods for capacity planning
	CO 3 Choose appropriate scheduling system for operations
	CO 4 Compare various types of inventory control
	CO 5 Develop various concepts for designing a product
	CO 6 Distinguish between several behavioral dimension
Renewable Energy & Sustainability 16ME6DERES	CO 1 Select the appropriate solar concentrators and tracking methods for harnessing solar energy
	CO 2 Estimate solar flux received from sun on flat and tilted surfaces, efficiency of flat plate and parabolic collectors
	CO 3 Flat plate and parabolic collectors for temperature distribution, Solar geometry and methods of measuring solar radiation and wind turbine designs
	CO 4 Experiment with flat plate and parabolic collectors and P-V panel set up
	CO 5 Alternate sources of energy and systems to generate power using them, methods of storing solar energy and methods of generating power using Bio Mass
	CO 6 Examine the domestic and industrial applications of Solar energy.
Theory of Plasticity 16ME6DETOP	
	CO 1 Analyze stresses and strains that exist within a body subjected to general type of loading
	CO 2 Predict the failure of components under multi axial loading based on yielding criteria.
	CO 3 Solve analytically the elastic-plastic problems of bending and torsion loads
	CO 4 Examine the theories of plastic flow, stress-strain relationships in plastic flow and the mechanism of plastic deformation
	CO 5 Formulate 1-D elastic-plastic boundary value problems with basic knowledge of computational aspects.
	CO 6 Utilize finite element simulation tools to solve plasticity problems with limited complexities (using Alternate Assessment Tool-AAT).
DESIGN LAB 16ME6DLDES	CO 1 Estimate the natural frequency for longitudinal, torsional and transverse systems. CO 2 Make use of Photo elasticity principles for stress analysis. CO 3 Determine Principal stresses and strains in members subjected to combined loading using Strain Rosettes and compare it with theoretical values

	CO 4 Examine the balancing of rotating masses CO 5 Experiment with different Governors and calculate equilibrium speed, sensitiveness, power and effort CO 6 Test for gyroscopic behavior under free and forced precession
Mechatronics 16ME7DCMCT	CO1: Summarize how mechatronics integrates knowledge from different disciplines in order to realize engineering and consumer products.
	CO2: Understand the fundamentals of simple electromechanical sensors.
	CO3: Analyze the general actuation elements of hydraulics, pneumatics & electrical systems.
	CO4: Study of various logical elements involved in different multi vibrators.
	CO5: Understand the functioning of various components of signal conditioning system.
	CO6: Make use of 8085 microprocessor for simple programming
Project Management & Financial Accounting 16ME7DCPMF	CO1: Classify projects and identify the phases of the life cycle of project.
	CO2: Plan a project, identify and estimate the resources required for its completion
	CO3: Create scheduling charts for projects and estimate critical path and project Completion time.
	CO4: Analyze the project with the aid of economic tools.
	CO5: Prepare various types of budgets.
Numerical Applications in Mechanical Engineering Lab. 16ME7DLNAM	
	CO1 APPLY algorithmic problem solving skills
	CO2 CREATE functions, scripts, programs which solve medium complex engineering tasks.
	CO3 DEVELOP solutions to mathematical models applied to practical
	Mechanical engineering problems.
	CO4 UTILIZE Matlab software to simulate practical problems
Product Design & Manufacturing 16 ME 7DE PDM	
	CO1 Understand the characteristics of successful product development
	CO2 Identify and collect customer needs
	CO3 Generate concepts, select and test
	CO4 Understand the importance of Architecture and industrial design
	CO5 Decide for prototype
	CO6 Understand economics of projects

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Hydraulics and Pneumatics 16ME7DEHAP	
	1. Understanding the operating principle, performance and selection procedure of hydraulic elements and evaluate pump and actuator performance and justify selection of pumps and actuators for various applications.
	2. Understand the working principle of various control elements and applying them for designing a circuit for a given application.
	3. Design and analyze hydraulic circuits.
	4. Understand the working of pneumatic systems and their control.
	5. Identify various components of Electro-pneumatic system &
	Trouble shooting of the pneumatic and hydraulic systems.
	6. Design of pneumatic and hydraulic circuits for the industrial applications.
	7. Virtual simulation of safety circuits and its effectiveness.
	8. Evaluation of performances of fluid power components.
Tribology & Bearing Design 16ME7DETBD	CO 1 Describe engineering significance of tribology, regimes of lubrication and understand the principle of viscosity measurement
	CO 2 Design concept of lightly loaded journal bearing and pressure development mechanism.
	CO 3 Apply the Reynolds 2D equation for full journal bearing and slider bearings operating under hydrodynamic condition and estimate design parameters.
	CO 4 Estimate the design parameters of Hydrostatic bearings
	CO 5 Choosing the materials for bearing construction
	CO 6 Understand the working principle of Magnetic bearings and develop design solutions.
Additive Manufacturing 16ME7DEADM	CO1:Compare various processes of AM and with other manufacturing process CO2:Analyze the process parameters for manufacturing AM parts CO3:Make use of the technology available to recognize processes CO4:Select a ideal process plan for AM part manufacturing CO5:Plan the operations and substantiate the use of AM CO6:Recognize the various parts of machines that involve AM processes
Advanced Robotics 16ME7DEARB	
	CO 1 Solve for velocity and static forces in manipulators
	CO 2 Formulate dynamic equations of robot manipulators
	CO 3 Design controllers for robot motion
	CO 4 Apply the techniques of computer vision to robot manipulation
	CO 5 Select proper actuators, drives and sensors for robot design
	CO 6 Design and build simple robots
Fracture Mechanics	

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<table>
<tr><td>16ME7DEFRM</td><td>CO1: Understand the concept of linear elastic fracture mechanics and apply it to stress analysis of a cracked body
CO2: Compute crack tip stress intensity factor for 2-D and 3-D cracked bodies made up of linear elastic materials
CO3: Understand the concept of elastic plastic fracture mechanics
CO4: Understand energy approach and apply to stress analysis of fatigue cracks
CO5: Understand various crack growth laws and apply to spectrum loading
CO6: Understand the various fracture toughness measuring techniques and correlate with fracture mechanics</td></tr>
<tr><td>16ME7IEOPR
Operation Research</td><td><table>
<tr><td>CO1</td><td>Formulate a real-world problem as a mathematical programming model.</td></tr>
<tr><td>CO2</td><td>Formulate and solve transportation models by applying cost cutting strategies.</td></tr>
<tr><td>CO3</td><td>Formulate and solve assignment models and travelling salesmen problems.</td></tr>
<tr><td>CO4</td><td>Construct a project network and apply program evaluation review technique and critical path management.</td></tr>
<tr><td>CO5</td><td>Employ Game theory for strategic decision making</td></tr>
</table></td></tr>
<tr><td>Nano Technology
16ME7IENAT</td><td><table>
<tr><td>CO1</td><td>Understand the history of nanotechnology, its relevance w.r.t. multi-disciplinary subjects</td></tr>
<tr><td>CO2</td><td>Identify the various experimental tools available for investigating & manipulating at the nano scale</td></tr>
<tr><td>CO3</td><td>Distinguish the various nano-particles, their synthesis & applications</td></tr>
<tr><td>CO4</td><td>Compare the polymeric and metallic nano-composites</td></tr>
<tr><td>CO5</td><td>Choose the nano-composites for various applications such as, electrical, mechanical applications and so on.</td></tr>
<tr><td>CO6</td><td>Identify the various nano-sensors & their applications.</td></tr>
</table></td></tr>
<tr><td>Project Work – Phase 1
16ME7DCPW1</td><td>1 Apply critical thinking in identifying problems & develops innovative and creative ideas/solutions/options employing appropriate quantitative methods and use relevant information technology
2 Exhibit honesty and integrity and sensitive to ethical and diversity issues and behaves in an ethical and professional manner 3 Demonstrate effective leadership abilities for the purpose of organizational growth and change.
4 Effective interpersonal skills and the ability to work successfully in teams of diverse composition
5 Construct coherent written forms of communication and present effective oral forms of communication.
6 Understand the implication of solutions provided on society and environment.</td></tr>
</table>

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Operation Research 16ME8DCORE	CO 1 Understand and apply the LPP method for practical problems. CO 2 Analyse and apply the transportation and assignment methods for practical problems. CO 3 Analyse and develop appropriate models for gaming problem. CO 4 Analyse sequencing of machines using Johnson's rule and graphically. CO 5 Analyse replacements of items that deteriorate with time.
Intellectual Property Rights 16HS8DCIPR	CO 1 Ability to comprehend the importance of IPR, Constitutional aspects of IP, Patent Systems of various countries CO 2 Explain Patent system in India, procedure to obtain Patent, Patentable and non-patentable inventions, transfer of Patent and Infringement of Patent CO 3 Illustrate Copyrightable works, understand Indian Copyright Law and infringement of Copyright CO 4 Appreciate Trademark System, procedure for registering Trademark and infringement of Trademark
Non Destructive Testing 16ME8DENDT	CO 1: Make students understand the working principle, Advantage and Applications of various Non-Destructive methods available for testing engineering components. CO 2: Identify, Classify, Compare and Select various NDT method or a combination of NDT methods for a given application. CO 3: Conduct a suitable NDT on a component with defect and compare it with a defect free component. CO 4: Study, Understand and present a case study of NDT application in a real world scenario. CO 5: Design a solution using various NDT method for Society practical problems.
Power Plant Engineering 16ME8DEPPE	CO 1 Understand the working of various components used in steam power plant, diesel power plant, hydroelectric power plant and nuclear power plant and the effect of power and wastes produced on society, public health and environment. CO 2 Identify various equipment required for power generation in various power plants. CO 3 Design chimneys for power generation in steam power plant and layout of diesel engine power plants. CO 4 Determine condenser efficiency, quantity of cooling water in steam power plant, cost of diesel power plants, power produced by diesel power plants hydroelectric power plants and nuclear power plants.

<table>
<tr><td></td><td>CO 5 Select appropriate devices for storage of fuel, combustion of fuel, handling of fuel, and improve the plant performance.</td></tr>
<tr><td></td><td>CO 6 Estimate load factors, plant capacity, utilization factor, demand and supply.</td></tr>
<tr><td></td><td>CO 7 Examine the feasibility of project.</td></tr>
<tr><td></td><td>CO 8 Comparison of site selection criteria for various power plants</td></tr>
<tr><td></td><td>CO 9 Elaborate an environmental effects of power generation</td></tr>
<tr><td></td><td>CO 10 Literature survey on latest developments on power generation.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Automotive Engineering
16ME8DEAUE</td><td><table>
<tr><td>CO1</td><td>Understand the construction and functions of components of IC engine</td></tr>
<tr><td>CO2</td><td>Understand the Vehicle performance parameters and improving them</td></tr>
<tr><td>CO3</td><td>Understand the different engine systems and transmission systems used in IC engines</td></tr>
<tr><td>CO4</td><td>Understand the Propeller shaft and final drive systems.</td></tr>
<tr><td>CO5</td><td>Application of basic electronic components in automobiles. Alternate energy and propulsion systems.</td></tr>
</table></td></tr>
<tr><td>Financial Management
16ME8IEFIM</td><td><table>
<tr><td>CO1:Compare the different forms of organizations and measure returns and risk under different economic conditions.</td></tr>
<tr><td>CO2:Estimate the working capital required to manage a firm’s working capital efficiently.</td></tr>
<tr><td>CO3:Propose suitable form of long term financing.</td></tr>
<tr><td>CO4:Examine a firm’s financial statement and evaluate its performance</td></tr>
<tr><td>CO5:Prepare cost sheets and compute variances</td></tr>
<tr><td>CO6:Plan different types of budgets</td></tr>
</table></td></tr>
<tr><td>Organizational Behaviour
16ME8IEORB</td><td><table>
<tr><td>CO1</td><td>Understanding Individual behavior, differences and its effects</td></tr>
<tr><td>CO2</td><td>Understand importance of learning and role of perception</td></tr>
<tr><td>CO3</td><td>Importance of motivation and groups</td></tr>
<tr><td>CO4</td><td>Understanding Conflict and stress management</td></tr>
<tr><td>CO5</td><td>Basics of communication</td></tr>
</table></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Project Work – Phase 2
16ME8DCPW2</td><td>1 Apply critical thinking in identifying problems & develops innovative
and creative ideas/solutions/options employing appropriate quantitative methods and use relevant information technology
2 Exhibit honesty and integrity and sensitive to ethical and diversity</td></tr>
</table>

	issues and behaves in an ethical and professional manner 3 Demonstrate effective leadership abilities for the purpose of organizational growth and change. 4 Effective interpersonal skills and the ability to work successfully in teams of diverse composition 5 Construct coherent written forms of communication and present effective oral forms of communication. 6 Understand the implication of solutions provided on society and environment.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF MECHANICAL ENGINEERING

Name of the Programme	**M.Tech in Manufacturing Science & Engineering**
PEOs	1. Graduates will have knowledge in the discipline of Materials and Manufacturing processes with hands on practice in using advanced material characterization and advanced manufacturing technology to address real world engineering problems. 2. Graduates will be successful in their career independently or in a group as materials and manufacturing professionals in an Industry/Research /Academia. 3. Graduates will be proficient in their communication, presentation skills and will be prepared to engage in the process of life-long learning through professional development and research.
Programme Outcomes (POs)	1. An ability to independently carry out research /investigation and development work to solve practical problems. 2. An ability to write and present a substantial technical report/document. 3. An ability to demonstrate mastery in the area of Manufacturing Science and Engineering at a level higher than the undergraduate program in Mechanical Engineering.
Course Outcomes (COs)	**I SEMESTER** **CORE** **Machining Science & Technology(18MEMSPCMS)** CO1: Analyze cutting forces in turning and learn problem solving skills in both analytical and graphical methods. Categorize cutting force measuring instruments and choose them for a particular application. Outline tool wear, tool geometry, tool temperature and parameters influencing tool life. Estimate machining costs CO2: Summarize nontraditional machining techniques and highlight the importance of NTM. Illustrate mechanism of material removal describe the process parameters, advantages & limitations, applications and model for material removal rate for industrially relevant NTM techniques. Describe advanced machining techniques CO3: Make oral presentations and prepare report on analytical and simulation models **Materials Characterization (18MEMSPCMC)** CO1: Analyze qualitatively and quantitatively different materials structure using advanced diffraction techniques, XPS instrumentation and patterns CO2: Explain and analyse materials using advanced spectroscopy techniques CO3:Select appropriate characterization methods to the analysis and characterization of materials CO4:Read and Write technical report/document regarding material characterization

Plasticity and Metal Forming(8MEMSPCPM)

CO1: Describe elastic and plastic behavior of metals. Differentiate metal working techniques and describe parameters influencing metal working

CO2: Estimation of forming loads in forging, rolling, extrusion and drawing. Analyze process variables

CO3: Make oral presentations and prepare report on analytical and simulation models

Composite Materials (18MEMSPCCM)

CO1: Identify the different reinforcement and matrix materials to synthesis components which find its innovative applications and service conditions.

CO2: Develop mathematical models for evaluating mechanical properties and failure criteria laminates. Failure analysis and design considerations of laminates

CO3: Analyze the current research and present case studies with technical reports.

ELECTIVE-1

Nano Technology(18MEMSPENT)

CO1: Understand the classification and fabrication of nano-composites, identify their applications

CO2; Analyze physical, mechanical and thermal properties of nano composites properties using modern tools such as SEM, XRD, DMTA, TGA, DSC

CO3: Present case studies with technical reports on current research in the relevant field

Total Quality Management (18MEMSPETQ)

CO1: Describe management policies of quality control and implementation of quality standards. Develop an understanding on the necessary information and skills needed to manage, control and improve quality practices in the organization through TQM Philosophy

CO2: Apply the reactive and proactive improvement methodologies for problem solving in organizations. Demonstrate the importance of team work in problem solving processes. Analyze implementation of quality by design

CO3: Present case studies with technical reports on current research in the relevant field

Corrosion and Surface Engineering (18MEMSPECS)

CO1: Analyze different forms of corrosion, corrosion mechanisms in industries and selection of different corrosion resistance materials by conducting various corrosion tests to minimize industrial corrosion.

CO2: Corrosion control using conventional & special coating techniques and coating characterization.

CO3: Present case studies with technical reports on current research in the relevant field

ELECTIVE-2

Advanced Joining Process (18MEMSPEAJ)

CO1: Classify various welding processes according to their importance and evaluate best method of inspection of welds

CO2: Identify weld symbols and their need, Design the welded joints with conventional and computer aided procedures. Challenges in welding of composites and dissimilar metals

CO3:Analyze the current research and present case studies with technical reports

Additive Manufacturing Technology(18MEMSPEAT)

CO1; Analyze additive manufacturing systems for new product development and give a detailed technical report on current research

CO2: Evaluate the best additive manufacturing method for product development make use of current software tools

CO3: Give a detail presentation of current additive manufacturing systems used in various industries with some case studies

Advanced Manufacturing Processes (18MEMSPEAM)

CO1: Describe plastic injection molding and metal injection molding techniques to synthesize various components. Application of Plastic forming techniques and High velocity forming techniques for modern materials

CO2: Illustrate mechanical alloying and powder metallurgy processes for ceramic materials.

CO3: Present case studies with technical reports on current research in the relevant field

LAB

Material Characterization And Manufacturing Technology Lab (18MEMSPCMM)

CO1: Analyse microstructure and characterize elements, compounds of materials

CO2: Estimate Process capabilities for different materials using abrasive water jet and wire EDM

CO3: Understand 3D Scanning and 3D printing of simple components

Research Methodology(18ALLPICRM)

CO1: Ability to write and present a substantial technical report/document

CO2: Able to demonstrate a degree of mastery over the area of specialization

II SEMESTER

CORE

Tool Engineering Design (18MEMSPCTD)

CO1: Analyze tool design procedure, forces in turning, milling & drilling and design of tools for the same. Choose inspection tools and design them

CO2: Design of jigs and fixtures and press tools for blanking, bending and drawing operations. Construct tool drawings.

CO3: Make oral presentations and prepare report on advancements in tooling

Industrial Robotics(18MEMSPCIR)

CO1: Analyze the manipulator design including actuator, drive and sensor issues

CO2: Students will be familiarized with the kinematics of robot, trajectory plan and document the motion diagrams for Industrial robots

CO3: Students will be familiarized with Micro and Nano robotics and its applications

Finite Element Modeling (18MEMSPCFM)

CO1: Apply fundamentals of theory of elasticity to continuum problems.

CO2: Formulate finite elements like bar, truss and beam elements for linear static structural analysis.

CO3: Develop models for 2D and axisymmetric finite elements

CO4: Solve problems of limited complexity in structural domain

CO5: Utilize finite element software to simulate practical problems

ELECTIVE III

Computer Control Of Manufacturing Systems (18MEMSPECC)

CO1: Illustrate NC and CNC machining centers and categorize the interpolators, control loops and feedback devises used in manufacturing systems and give a detailed technical report on current research trends

CO2: Compose Part programming using Manual and APT for deferent machining operations

CO3: Describe design principles and optimize controller motion for a modern machining scenario and give a detailed technical report

Design For Manufacture (18MEMSPEDM)

CO1; Selection of materials and processes for designed component

CO2: Design of inspection, cutting tools & fasteners, casting, injection moulding & die casting, sheet metal operation and powder metallurgy tools

CO3: Make oral presentations and prepare report on current research on product design

Industrial Design and Ergonomics(18MEMSPEID)

CO1: Illustrate general approaches to the man- machine relationship and design of work station and analyze various control and displays in various industries give a oral presentation

CO2: Design and develop an effective expert systems for ergonomic design and Identify visual effects of line & form and analyze mechanics of seeing psychology with some case studies

CO3: Design an industrial equipment in perspective of ergonomics and give a detailed technical reports on ergonomic standards used in industries

ELECTIVE IV

Advanced Engineering Materials(18MEMSPEAE)

CO1: Describe different types of advanced ferrous, nonferrous, semi & super conducting materials with properties and applications in engineering components

CO2: Categorize polymeric materials and ceramic materials with various processing techniques

CO3: Present case studies with technical reports on current research in the relevant field

Nondestructive Testing (18MEMSPEND)

CO1:Describe various NDT techniques, equipment, applications and limitations

CO2: Selection, application of appropriate NDT method for various components using NDT standards and interpretation of defects

CO3: Present case studies with technical reports on current research in the relevant field

Micro Electro - Mechanical Systems (Mems-18MEMSPEME)

CO1: Classify and apply the concepts of MEMS based on its applications. Synthesize the designed MEMS for pre defined application.

CO2: Modeling of MEMS to evaluate better performance. Identify control mechanisms of MEMS. Select a system packaging based on its performance

CO3:Present case studies with technical reports on current research in the relevant field

LAB

CNC and Robotics Lab (18MEMSPCCR)

CO1: Write and simulate CNC program for Turning and Milling

CO2: Document and report programs for CNC and Robot

CO3: Hands on programming and execution of Milling and Turning operations

Institution Engineering Electives offered by Manufacturing Science and Engineering

Computational Methods in Engineering Analysis (18MEMSOECE)

CO1: Construct and analyze mathematical models of physical applications. Find the roots of polynomials, algebraic, transcendental or simultaneous system of equations in science and engineering problems

CO2: Integrate and differentiate a function for given set of tabulated data with greater accuracy for engineering problems. Solve system of linear algebraic equations and compute eigen values and eigen vectors of matrices

CO3: Present case studies with technical reports on current

research in the relevant field

DESIGN OF EXPERIMENTS(18MEMSOEDE)

CO1: Choose an appropriate experiment to evaluate a new product design or process improvement through experimentation strategy, data analysis, and interpretation of experimental results

CO2: Plan, design, and conduct experimental investigations efficiently and effectively

CO3 Understand strategy in planning and conducting experiments and review recent advances in experimentation and give a oral presentation

III SEMESTER

Internship (18MEMSPCNT)

CO1: Understand the structure, culture, various industrial practices, professional ethics and working of an industry and gain awareness of possible careers.

CO2: Apply critical thinking in identification and solution of problems by integrating knowledge and skills. Perform efficiently in taking up assigned responsibilities. Communicate effectively and professionally

CO3: Prepare technical reports and make oral presentation

Project Work (I Phase) (18MEMSPCPJ-1)

CO1: Choose a problem applying relevant knowledge and skills acquired during the course in the domain. Formulate the specifications of the project work, identify a set of feasible solutions and prepare and execute project plan considering professional, cultural and societal factors. Conclude problem solving methodology using literature survey and present the same

CO2: Develop experimental planning and use appropriate techniques and tools to conduct experiments. Evaluate and critically examine the outcomes. Conclude the results and identify relevant applications.

Technical Seminar (18MEMSPCSR)

CO1: Identify and select a research/journal paper related to materials, characterization, manufacturing or analysis

CO2: Understand the content of the selected research/journal paper

CO3: Prepare a technical seminar report and communicate effectively through oral presentation using multimedia tools

Program Core

Product Lifecycle Management (18MEMSPCPL)

CO1: Analyze product lifecycle management systems for new product development and give a detailed technical report on current research

CO2: Evaluate and make use of the best tools and practices for product development make use of current software tools

	and evaluation models CO3: Give a detail presentation of current PLM based systems and architecture for manufacturing and allied industries with some case studies **IV SEMESTER** **Program Elective (Management Stream)** **Business Analytics(18MEMDOEBA/18MEMSOEBA)** CO1: To analyze data in realtime environments for meaningful decision making in industries. CO2: To predict events and develop plans for new processes and system analysis. CO3: To improve the process through optimization techniques for quick decision making**.** **Project Work (PHASE-II) (18MEMSPCPJ-2)** CO3: Document the findings and write a report in the prescribed format. Demonstrate working knowledge of ethics and professional responsibility at different stages such as problem formulation, designing the experiments, implementation and presentation. Present and publish the outcomes of the project work in a journal/conference

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF MECHANICAL ENGINEERING

Name of the Programme	M. Tech. in Machine Design
Programme Educational Objectives (PEOs)	1. Graduates will have knowledge in the discipline of Machine Design with hands on skill in using modern engineering tools to address real world engineering problems and be socially responsible. 2. Graduates shall be successful in their career as analysts and designers of structural components of conventional and advanced materials, participating in a team or individually in an industry, research or academia. 3. Graduates shall be proficient in their communication, presentation and will be prepared to engage in the process of life-long learning through professional development and research.
Programme Outcomes (POs)	1. An ability to independently carry out research /investigation and development work to solve practical problems. 2. An ability to write and present a substantial technical report / document. 3. An ability to demonstrate mastery in the area of 'Machine Design', at a level higher than the undergraduate program in 'Mechanical Engineering'.
Course Outcomes (COs)	
ADVANCED MECHANICS OF SOLIDS (18MEMDPCAS)	CO 1: Apply basic concepts in continuum mechanics of solids viz. Stress and strain tensors, equilibrium, compatibility and constitutive equations and methods of solution to elasticity problems CO 2: Evaluate stresses and displacements in simple solids such as pressurized cylinders, shrink fitted cylinders, rotating disc and shaft, plate with hole and non-circular shafts and thin tubes under torsion. CO 3: Use MATLAB or equivalent software to evaluate and plot particular solutions. CO 4: Apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints.
DYNAMICS AND MECHANISM DESIGN (18MEMDPCDM)	CO1: Carry out mobility analysis of mechanism.

	CO2: Synthesize mechanisms for function generation and path generation. CO3: Analyze the Dynamics of Mechanical systems using D'Alemberts, Lagrange's, and Hamiltons Principles. CO4: Demonstrate the skills to use software to analyze practical mechanisms.
ADVANCED MACHINE DESIGN 18MEMDPCAD	CO1: Predict failure of engineering components using appropriate failure theories. CO2:Identify and explain the types of fractures of engineered materials and their characteristic features; CO3: Estimate life of components using stress life, strain life and LEFM approach. CO4: Analyze the machine members subjected to spectrum loads.
FINITE ELEMENT METHOD 18MEMDPCFE	CO1: Develop governing equation for a mechanical system and apply principles of variation and integral formulation to formulate finite element equations. CO2: Formulate one dimensional, two dimensional and axisymmetric elements. CO3: Analyse problems related to 1D, 2D and solids of revolution. CO4: Develop mass matrices and compute eigen values and eigen vectors for a 1D and 2D analysis of mechanical components. CO5: Demonstrate the use of commercial FEA packages to solve complex practical problems.
COMPOSITE MATERIALS TECHNOLOGY 18MEMDPECM	CO1: Identify the role of matrices and reinforcements used in practical composite structures. CO2: Analyze problems on micro and macro mechanical behavior of lamina. CO3: Assess the strength of laminated composite and predict its failure for given static loading conditions. CO4: Develop understanding of different methods of manufacturing and testing of composites. CO5: Make oral presentation on recent advancements in the field of composite materials and structures.
MECHATRONICS SYSTEM DESIGN 18MEMDPEMD	CO1: Appreciate multi-disciplinary nature of modern engineering systems. CO2: Model and analyse mechanical and electrical systems and their connection.

	CO3: Be able to integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems. CO4: Address issues of design, fabrication, and packaging issues of Microsystems.
ROBUST DESIGN 18MEMDPERD	CO1: Apply Design of Experiments (DOE) techniques to various methods of design. CO2: Analyse and evaluate design parameters using different design strategies. CO3: Illustrate through numerical examples improvements in design parameters. CO4: Perform case studies involving identification of parameters, analysis of experimental data in a robust design.
COMPUTATIONAL METHODS IN ENGINEERING ANALYSIS 18MEMDPECE	CO1: Construct and analyse mathematical models of physical applications. CO2: Find the roots of polynomials, algebraic, transcendental or simultaneous system of equations in science and engineering problems. CO3: Integrate and differentiate a function for given set of tabulated data with greater accuracy for engineering problems. CO4: Solve system of linear algebraic equations and compute eigen values and eigen vectors of matrices. CO5: Demonstrate use of computational tools like MATLAB to obtain solution to complex mathematical models.
STATISTICAL MODELING AND EXPERIMENTAL DESIGN 18MEMDPESE	CO1: Statistically model a population and fit in a suitable distribution for the population for further analysis. CO2: Analyse and apply statistical concept in the design of experiments. CO3: Develop experimental models for 2 factors or 3 factors. CO4: Establish a regression pattern for given mathematical model established for experiment and evaluate signal to noise ratio for sensitivity.
OPTIMIZATION TECHNIQUES 18MEMDPEOT	CO1: Formulate engineering optimization problem and solve LPP by simplex method. CO2: Solve single and multivariable optimization problem by various relevant

	method. CO3: Develop algorithm for constrained optimization. CO4: Examine various optimization techniques and demonstrate their applicability.
FRACTURE MECHANICS 18MEMDPCFM	CO1:Develop governing equations based on theory, concepts and principles of fracture mechanics CO2:Apply principles to characterize status of crack in a structure under different loads and perform failure analysis of engineering structures CO3:Solve theoretical and practical problems to acquire judgment and skills CO4:Evaluate fracture mechanics parameters, predict crack propagation and provide alternate solutions CO5: Simulate and analyze behavior of cracked structure using a commercial analysis tool to perform fracture mechanics analysis.
VIBRATIONS AND ACOUSTICS 18MEMDPCVA	CO1: Model and analyse a free damped, undamped and forced response of a mechanical system. CO2: Develop equation and analyse the transient response of a single degree freedom system. CO3: Assess the response characteristics of a continuous mechanical system. CO4: Analyse and discuss the behaviour of single degree freedom system for linear and non-linear behaviour. CO5: Undertake literature review on unfamiliar problems related to vibration, comprehend it and make presentation to the engineering community.
TRIBOLOGY 18MEMDPCTR	CO1: Comprehend basics of tribology and related sciences, theoretical background about processes in tribological system, mechanisms and forms of interaction of friction surfaces. CO2: Analyze hydrodynamic, hydrostatic bearing. CO3: Select bearings based on various tribological factors to be considered in moving and rotating parts. CO4: Understand the application and limitations Magnetic and porous bearings. CO5: Undertake literature survey on

	unfamiliar problems related to Tribology, comprehend it and make presentation to the engineering community.
THEORY OF PLASTICITY 18MEMDPETP	CO1: Analyse and determine the elastic and elastoplastic stress- strain behaviour of solid deformable bodies subjected to various types of loads. CO2: Analyse and asses the yielding behaviour in metallic material using suitable yield criteria. CO3: Develop plastic stress-strain relation for large plastic deformation and apply same along with knowledge of yield criteria to various metal forming process. CO4: Develop fundamental equations of slipline field theory.
ROTOR DYNAMICS 18MEMDPERT	CO1: Model a rotating machine element theoretically for rotor dynamic analysis. CO2: Analyse Free and Forced lateral response of simple rotor models and of more complex systems including shafts, bearings, seals and stators. CO3: Formulate Finite element and carry out analysis for Turborotor System Stability. CO4: Apply Finite element approach to blade vibration.
THEORY OF PLATES AND SHELLS 18MEMDPETS	CO1: Understand and develop basic equations for thin plates. CO2: Develop pure bending equations for circular and rectangular plates. CO3: Analyze the rectangular plates using Navier and Levy approach. CO4: Develop equations for combined loading on plates.
EXPERIMENTAL MECHANICS 18MEMDPEEM	CO1: Understand functional requirements of a generalized measurement system and identify suitable components for an application. CO2: Use concepts of Data Acquisition, Processing and apply the same for interpretation and analysis of experimental data. CO3: Determine stresses and strains in a structure using different methods such as strain gages, photo-elasticity, brittle coating and holography. CO4: Identify and apply suitable experimental stress analysis to practical problems.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

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DEPARTMENT OF MECHANICAL ENGINEERING

DESIGN FOR MANUFACTURE 18MEMDPEDF	CO1: Understand the role of manufacture and assembly in development of mechanical parts and their assemblies. CO2: Apply manufacturing considerations in the design and development of components made of casting and machining. CO3: Apply geometrical dimensioning and tolerances issues in mechanical design.
ROBOTICS 18MEMDPERB	CO1: Formulate a representation for links using Denvit-Hartenberg parameters. CO2: Derive and analyze the velocity and statics of a manipulator. CO3: Plan and develop trajectory with different schemes. CO4: Characterize and choose different actuators and sensors for robotic applications.
SIMULATION LABORATORY 18MEMDPCSL	CO1: Develop finite element models for static and dynamic analysis CO2: Apply boundary conditions and analyze the problems to evaluate primary variables. CO3: Solve and simulate real-time problems for stress and failure in different domains like structures, thermal, fluid flow, fatigue, etc. CO4: Demonstrate skills in use of reputed commercial finite element analysis package
INTERNSHIP / INDUSTRIAL TRAINING 18MEMDSRTS	CO1: Design/ appraise the working of a system/organization, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. CO2: Function in multi-disciplinary teams CO3: Identify, formulate, and solve engineering problems CO4: Understand professional and ethical responsibility CO5: Gain knowledge of contemporary issues CO6: Use the techniques, skills, and modern engineering tools necessary for engineering practice
TECHNICAL SEMINAR 18MEMDSRTS	CO1: Identify and understand current trends and real-world issues related to topics in Machine Design.

	CO2: Classify appropriate content and sources, through literature survey, that can be summarised and integrated into presentation CO3: Review, analyse, and interpret data & results using critical thinking skills CO4: Revise and present scientific case studies in presentation CO5: Collaborate effectively with other students in analysing results and preparing oral presentations CO6: Prepare a technical seminar report and communicate effectively through oral presentation using multimedia tools
PROJECT WORK 18MEMDPCPR	CO1: Apply relevant knowledge and skills acquired during the course in the domain to the problem on hand CO2: Formulate the specifications of the project work, identify a set of feasible solutions and prepare and execute project plan considering professional, cultural and societal factors CO3: Extract information pertinent to problem using literature survey CO4: Analyze independently and discuss complex issues CO5: Use appropriate techniques and tools to conduct experiments, analyze data CO6: Evaluate and critically examine the outcomes of one's own work and others' work CO7: Draw suitable conclusions based on the results and identify relevant applications CO8: Document the findings and prepare a report in the prescribed format CO9: Demonstrate working knowledge of ethics and professional responsibility at different stages such as formulation, design, implementation, and presentation CO10: Publish the outcomes of the project work in a reputed journal, make effective presentation of the work and communicate confidently in defending the work

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF MECHANICAL ENGINEERING

Name of the Programme	M. Tech. in Thermal Engineering
Programme Educational Objectives (PEOs)	4. Graduates will have knowledge in the discipline of Thermal Engineering with hands on skill in using modern engineering tools to address real world engineering problems and be socially responsible. 5. Graduates shall be successful in their career as analysts and designers of structural components of conventional and advanced materials, participating in a team or individually in an industry, research or academia. 6. Graduates shall be proficient in their communication, presentation and will be prepared to engage in the process of life-long learning through professional development and research.
Programme Outcomes (POs)	4. An ability to independently carry out research /investigation and development work to solve practical problems. 5. An ability to write and present a substantial technical report /document 6. An ability to demonstrate mastery in the domain of the specialization of the program.
Course Outcomes (COs)	
APPLIED MATHEMATICS 19METHPCAM	CO 1: Acquire the idea of significant figures, types of errors during numerical computation. CO 2: Develop the mathematical models of thermal system using ODE's and PDE's. CO 3: Learn the deterministic approach for statistical problems by using probability distributions. CO 4: Demonstrate the validity of the hypothesis for the given sampling distribution using standard tests and understand the randomization on design of experiments. CO 5: Classify and analyze mathematical tools applied to thermal engineering study cases.
ADVANCED FLUID MECHANICS 19METHPCAF	CO1: Apply the concepts of governing equations for fluid flow problems. CO2: Formulate and solve one dimensional incompressible and compressible low problems.

	CO3: Evaluate the properties of fluid flow using boundary layer theory.
ADVANCED THERMODYNAMICS 19METHPCAT	CO1: Apply the concepts of basic thermodynamic for analyses of thermal energy systems. CO2: Construct Psychrometric chart and to develop the thermodynamic properties of refrigerants. CO3: Understand the concepts of combustion phenomena and chemical reaction in energy conversion devices. CO4: Apply the knowledge of compressible flow and design flow devices. CO 5: Understand the irreversibility for designing thermoelectric and thermomechanical instruments.
FINITE ELEMENT METHODS FOR HEAT TRANSFER ANALYSIS 19METHPCFE	CO1: Introduce the various aspects of FEM as applied to thermal engineering problems. CO2: Formulate one dimensional, two dimensional, three-dimensional and axisymmetric elements. CO3: Apply the fundamental concepts of mathematical methods to solve Heat Conduction, Transient and Convective Heat Transfer problems. CO4: Analyse problems related to 1D, structural problems. CO5: Demonstrate the use of commercial FEA packages to solve complex practical problems.
THEORY OF IC ENGINES 19METHPEIC	CO1: To understand the working cycle, Engine design and operating conditions, combustion phenomena, Engine emission and control. CO2: Use of alternate fuels in IC engines. CO3: Identify the various types of emissions ,noise and their control systems CO 4: Recommend the suitable alternative fuel for IC Engine.
NON-CONVENTIONAL ENERGY RESOURCES 19METHPENC	CO1: Apply the concepts of energy equations on Non-conventional energy technologies for their performance improvement. CO2: Evaluate the performance of the devices working on different energies. CO3: Solve for performance characteristics of Non-conventional energy devices.
CRYOGENIC ENGINEERING 19METHPECG	CO1: Understand the working principles

	and applications of different types of gas liquefaction and refrigeration systems. CO2: Understanding the governing laws and principles of gas separation. CO3: Study on cryocoolers and its applications. CO4: Understanding the working and applications of vacuum technology. CO 5: Understanding the working of Cryogenic measuring instruments. CO 6: Understanding the importance of cryogenics insulations and Safety in Cryogenics.
GAS DYNAMICS 19METHPEGD	CO1: Apply continuity, momentum and energy equations to compressible flows. CO2: Analyze isentropic and non-isentropic flows across normal shock waves. CO3: Solve compressible flow problems involving heat transfer and friction.
REFRIGERATION AND AIR CONDITIONING 19METHPERA	CO1: Understand the working principles and applications of different types of refrigeration systems CO2: Study the working of air conditioning systems and their applications CO3: Identify the performance parameters and their relations of an air conditioning system CO4: Understand conventional and alternate refrigerants and their impact on environment.
ENGINE FLOW AND COMBUSTION 19METHPECE	CO1: Study the Inlet& exhaust processes of I C Engine. CO2: Understand the combustion phenomenon of I C Engines pollutant formation CO3: Study the combustion models and emission norms.
RESEARCH METHODOLOGY 18ALLPICRM	CO1: Ability to write and present a substantial technical report/document CO2: Able to demonstrate a degree of mastery over the area of specialization
THERMAL ENGINEERING LAB 19METHPLTE	CO1: Evaluate the fluid flow properties experimentally. CO2: Evaluate the different performance properties parameters of I.C. engines.
ADVANCED HEAT TRANSFER 19METHPCAH	CO1: To develop the ability to use the heat transfer concepts for various applications like finned systems, turbulence flows, high speed flows.

	CO2: To analyze the thermal analysis and sizing of heat exchangers and to learn the heat transfer coefficient for compact heat exchanges. CO3: To have an understanding of the numerical technique to handle heat transfer problems
STEAM AND GAS TURBINES 19METHPCSG	CO1: To understand the working principle, operations and analysis of nozzles, diffusers, steam and gas turbines. CO2: Summarize the working principles of Gas and steam turbines nozzle and diffusers. CO3: Use the principles of thermodynamics to determine the performance of steam and gas turbines. CO4: Identify the various losses associated with the turbines.
COMPUTATIONAL FLUID DYNAMICS 19METHPCCF	CO1: Apply stepwise procedure to completely solve a fluid dynamics problem using computational methods. CO2: Identify and implement numerical techniques for space and time integration of partial differential equations. CO3: Computationally solve the fluid properties for inviscid and viscous flows CO4: Evaluate the fluid flow properties using governing equations for different fluid flow phenomenon
CONVECTIVE AND RADIATIVE HEAT TRANSFER 19METHPECR	CO1: Understand the concept of boundary layer and determine the flow parameters in any heat transfer devices CO2: Analyse heat dissipative cooling equipments and heat pipes by knowing the concept of natural and forced convection CO3: Evaluate a radiation shape factor for radiative heat transfer between different surfaces CO4: Model the fundamentals of radiation in gaseous media.
NUCLEAR ENGINEERING 19METHPCNE	CO1: Understand the basic physics of nuclear reactions CO2: Basic concepts of nuclear fuel manufacturing and spent fuel handling CO3: Classification of nuclear reactors CO4: Understand working principle of thermal reactor CO5: Understand working principle of fast reactor

	CO6: Analyse the thermal hydraulics of nuclear reactors
DESIGN OF HEAT TRANSFER EQUIPMENTS 19METHPEDH	CO1: Understand the physics and the mathematical treatment of typical heat exchangers. CO2: Employ LMTD and Effectiveness methods in the design of heat exchangers and analyze the importance of LMTD approach over AMTD approach. CO3: Examine the performance of double-pipe counter flow (hair-pin) heat exchangers. CO4: Design and analyze the shell and tube heat exchanger. CO5: Understand the fundamental, physical and mathematical aspects of boiling and condensation. CO6: Classify cooling towers and explain their technical features.
ADVANCED POWER PLANT CYCLES 19METHPEAP	CO1: To provide a knowledge about the analysis of various cycles used for power generation, Combustion, kinetics involved in combustion. CO2: To impart knowledge about feed water circulation, working of FWH. CO3: Differentiate axial flow and radial flow gas turbines for their analysis. CO4: Identify the design parameters and economics of power plant.
SOLAR THERMAL TECHNOLOGIES AND ITS APPLICATIONS 19METHPESA	CO1: Analyse the energy concepts on solar devices for various thermal properties. CO2: Analyse the solar thermal devices for various tracking modes. CO3: Evaluate the performance of various solar thermal technologies.
PHASE CHANGE PHENOMENAN IN FLUIDS 19METHPEPC	CO1: Solve for temperature, pressure and enthalpy of Binary mixtures CO2: Solve the basic equations to determine velocity, pressure and temperature of multiphase flow CO3: Analyze pool and flow boiling phenomena to design the heat dissipative cooling equipment's CO4: Understand different flow pattern and its instability with bubble behavior CO5: Analyze condensation phenomena in the industrial and commercial equipment's.
MICRO FLUIDICS	CO1: Differentiate between traditional flow

19METHPEMF	and microfluidics. CO2: Derive expressions for microfluidic parameters CO3: Apply the principles of micro fluidics for coupling biology and fluid physics at microconfinement scale. CO4: Identify problems in micro manufacturing. CO5: Understand molecular simulation and Nano-fluidics (Theoretical Treatise)
INTERNSHIP / INDUSTRIAL TRAINING 19METHPCIN	CO1: Design/ appraise the working of a system/organization, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. CO2: Function in multi-disciplinary teams CO3: Identify, formulate, and solve engineering problems CO4: Understand professional and ethical responsibility CO5: Gain knowledge of contemporary issues CO6: Use the techniques, skills, and modern engineering tools necessary for engineering practice
EXPERIMENTAL METHODS IN THERMAL ENGINEERING 19METHPCEM	CO1: Apply the concepts of measurement on mechanical systems CO2: Carry out error and uncertainty analysis of thermal systems CO3: Analyse different measurement techniques for measurements of pressure and fluid flow
TECHNICAL SEMINAR 19METHPCTS	CO1: Identify and understand current trends and real-world issues related to topics in Thermal Engineering. CO2: Classify appropriate content and sources, through literature survey, that can be summarised and integrated into presentation CO3: Review, analyse, and interpret data & results using critical thinking skills CO4: Revise and present scientific case studies in presentation CO5: Collaborate effectively with other students in analysing results and preparing oral presentations CO6: Prepare a technical seminar report and communicate effectively through oral

	presentation using multimedia tools
ENERGY AUDITING 19METHPCEA	CO1: Forecast the short term load for decentralised load management CO2: Predict energy potential locally and globally CO3: Estimate electricity Tariff CO4: Optimise energy audit system CO5: Determine energy consumed by various thermal machines CO6: Plan demand side load management
PROJECT WORK 19METHPRP	CO1: Apply relevant knowledge and skills acquired during the course in the domain to the problem on hand CO2: Formulate the specifications of the project work, identify a set of feasible solutions and prepare and execute project plan considering professional, cultural and societal factors CO3: Extract information pertinent to problem using literature survey CO4: Analyze independently and discuss complex issues CO5: Use appropriate techniques and tools to conduct experiments, analyze data CO6: Evaluate and critically examine the outcomes of one's own work and others' work CO7: Draw suitable conclusions based on the results and identify relevant applications CO8: Document the findings and prepare a report in the prescribed format CO9: Demonstrate working knowledge of ethics and professional responsibility at different stages such as formulation, design, implementation, and presentation CO10: Publish the outcomes of the project work in a reputed journal, make effective presentation of the work and communicate confidently in defending the work

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DEPARTMENT OF ELECTRICAL ENGINEERING

Acacemic Year 2019-20

Name of the Programme	B.E. in Electrical Engineering
Programme Specific Outcomes (PSOs)	1. Develop models, analyze and assess the performance of different types of generation, transmission, distribution and protection mechanisms in power systems. 2. Design, develop, analyze and test electrical and electronics systems; deploy control strategies for power electronics related and other applications. 3. Measure, analyze, model and control the behavior of electrical quantities associated with constituents of energy or allied systems.
Programme Outcomes (POs)	PO1 to PO12
PO1	Engineering Knowledge: Apply the knowledge of mathematics and science engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	Problem Analysis: identify, formulate, review research literature, and analyze complex engineering problems reaching substantiate conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
PO4	Conduct investigations of complex problems: use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid solutions.
PO5	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.
PO6	The engineer and society: apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	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.
PO8	Ethics: apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
PO10	Communication: communicate effectively on complex engineering activities with the engineering community and with society at large such

	as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multi-disciplinary environments.
PO12	Lifelong learning: recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
Course Outcomes (COs)	The COs for all the courses offered - Core and electives
Course Name	**Course Outcomes**
	I & II Sem
Elements of Electrical Engineering	CO1: Understand the basic concepts of DC, AC circuits and Electrical Machines. CO2: Apply the basic knowledge of mathematics, science and electrical engineering to obtain the desired parameters/performance characteristics of Electric circuits and Machines. CO3: Analyse the behavior of Electric circuits, transformers and Electrical machines. CO4: Conduct a study on safety aspects, wiring and consumption of electrical power in domestic installations. CO5: Conduct experiments and study the performance of electrical machines, AC and DC circuits. CO6: Norms of engineering practice for domestic earthing.
	III Sem
ADVANCED ENGINEERING MATHEMATICS	CO-1:Obtain numerical solution a system of algebraic equations, algebraic and transcendental equations and ordinary differential equations. CO-2:Formulate boundary value problems involving one dimensional heat and wave equation. CO-3:Solve partial differential equations with appropriate boundary conditions using the method of separation of variables. CO-4:Construct analytic functions and simple conformal mappings. CO-5:Evaluate real and complex integrals using the calculus of residues.
LINEAR CIRCUITANALYSIS	CO-1: Formulate equations based on physical laws and analyze the steady state behavior of complex electric networks. CO-2: Apply the knowledge of mathematics and graph theory to the solution of complex electrical networks. CO-3: Apply mathematical and analytical techniques to analyze transient behavior of networks. CO-4: Analyze networks based on two port networks and state variables.
ANALOG MICROELECTRONICS	CO-1: Define, understand and explain the structure, V-I characteristics, working and applications of analog electronic devices like diodes, Bipolar Junction Transistors(BJTs) and MOSFETs. CO-2: Apply the knowledge of KVL and KCL to obtain voltage /current/waveform at different points in analog electronic circuits such as

	diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers. CO-3: Analyze analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers etc. to obtain voltage /current/waveform at different points for given specifications. CO-4: Design analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers for given specifications. CO-5: Conduct experiments using analog electronic components and electronic instruments to function as switch, regulator, clippers, clampers, small signal amplifiers, oscillators, power amplifiers CO-6: Engage in self-study/independent study to formulate, design, implement, analyze and demonstrate an application using analog electronic components through an open ended experiment. CO-7: Engage in self-study/independent study to submit a seminar report and make an effective presentation on topics related to the course (e-waste management, www.deity.gov.in, Comparative study of components, preparing the specifications of components, verifying the data sheets, applications of analog electronics).
DIGITAL ELECTRONICS	CO-1: Understand, define and explain the fundamental concepts of Digital circuits. CO-2: Applythe knowledge of digital circuit concepts (Boolean Algebra, K-Maps and Quine-McClusky method) to optimize a digital circuit for the given parameter (number of gates, time delay, power consumption, cost). CO-3: Analyze digital circuits and arrive at suitable conclusions. CO-4: Design a digital circuit for given specifications. CO-5: Conduct experiments using digital ICs for a given application/problem statement. CO-6: Engage in self-study to formulate, design, implement, analyze and demonstrate an application of digital electronic circuits through an open ended experiment. CO-7: Engage in self-study to deliver a seminar on topics related to the course accompanied by a seminar report (www.deity.gov.in, Comparative study of components, preparing the specifications of components, verifying the data sheets, applications of digital ICs, the characteristics/specifications of different digital ICs, etc.).
FIELD THEORY	CO-1: Apply the fundamental Knowledge of electrostatics. CO-2: Apply the fundamental Knowledge of magneto-statics. CO-3: Formulate and analyze problems involving different media with boundaries using uniform plane wave.
Simulation Lab -I	CO-1: Navigate the MATLAB user interface, enter commands, Create access, modify, perform calculations, and visualize matrix data and customize plots.

	CO-2: Import data from files, write and debug scripts and create functions. CO-3: Visualize and interpret three dimensional plots of functions and responses of electrical systems. CO-4: Create and simulate a model of a physical system. CO-5: Create mathematical models of systems such as controlled and uncontrolled rectifiers and determine the parameters associated with the output signal. CO-6: Interact with MATLAB workspace.
	IV Sem
Discrete Mathematics and Probability	CO-1: Understand the notation of set theory, relations and functions. CO-2: Construct a Hasse diagram for partial orderings, Use many terms associated with graphs and prove whether two graphs are isomorphic. CO-3: Obtain the probability of an event using discrete and continuous distributions, including the n-step transition probability. CO-4: Analyse and classify simple states (recurrent/transient). CO-5: Understand, derive and apply the properties of the M/M/m queuing model (properties like stationary probability, average waiting and system time, expected number of customers in the queue).
Analog Integrated Circuits	CO-1: Define, understand and explain the DC and AC performance characteristics of Opamp, applications of Opamp, working of 555 timer and voltage regulators. CO-2: Apply the knowledge of KVL and KCL to obtain voltage /current/waveform at different points in analog electronic circuits such as Opampamplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators ,555 timers. CO-3: Analyze analog electronic circuits such as Opamp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators, and 555 timers etc to obtain voltage/current/waveform at different points that meet desired specifications. CO-4: Design analog electronic circuits such as Opamp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators ,555 timers etc. that meet desired specifications. CO-5: Conduct experiments using analog electronic components, electronic instruments to function as amplifiers, comparators, rectifiers, filters, astable and monostable circuits using 555, data converters. CO-6: Engage in self-study/independent study to formulate, design, implement, analyze and demonstrate an application using analog electronic components/ASLK/Multisim through a mini-project and submit the mini-project and make an oral presentation of the work.

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MICROCONTROLLERS	CO-1: Understand and explain computer based and memory based architecture, microcontroller, pipelining, addressing modes, data types in Embedded C, basics of serial communication, timer configuration and interrupt handling. CO-2: Calculate instruction execution time, delay, baud rate, and write assembly and C Code, identify the timer mode, serial communication mode and interrupt priorities. CO-3: Debug/ analyze the code in assembly as well as Embedded C. CO-4: Identify the IDE to conduct experiments by simulating, debugging and executing the assembly and Embedded C code CO-5: Engage in independent study/ self-study by preparing a 5 min video on 'Applications of Microcontrollers for health, safety, environment and society'. CO-6: Work as an individual and as a team-member to design, formulate and implement experiments using microcontroller through conduction of an Open-Ended experiments.
CONTROLSYSTEMS	CO-1: Obtain mathematical models of open loop and closed loop physical systems. CO-2: Apply mathematical techniques to perform time response analysis of a control system. CO-3: Carry out stability analysis using different mathematical techniques.
SIGNALS AND SYSTEMS	CO-1: Apply the knowledge of mathematics and engineering to analyze and obtain the response of continuous and discrete time systems. CO-2: Analyze Continuous Time and Discrete Time signals and systems in Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT. CO-3: Analyze Discrete Time systems using Z-transforms.
Simulation Lab -II	CO-1: Develop simulation circuit for a given electric network and verify KVL and KCL. CO-2: Design and analysis of power amplifier, Inverting and Non inverting amplifiers and oscillator circuit through simulation. CO-3: Develop circuit model to analyze a second order system and perform stability studies. CO-4: Develop circuit model and apply circuit theorems.
Mathematics-I	CO-1: Understand the basic concepts of differentiation and integration. CO-2: Apply the concepts of polar curves and multivariate calculus. CO-3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations. CO-4: Apply techniques of vector calculus to engineering problems. CO-5: Comprehend the generalization of vector calculus in curvilinear coordinate system
MATHEMATICS-II	CO-1:Use Laplace transforms to solve differential equations. CO-2:Apply double integrals to compute areas. CO-3:Learn to use triple integrals in computing volumes. CO-4: Use Gamma and Beta functions to evaluate integrals. CO-5: Understand the use of integral calculus in scalar and vector fields.

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	V Sem
TRANSMISSION AND DISTRIBUTION	CO1:Select a suitable insulator & design the transmission line for the required sag. CO2:Develop mathematical models of the transmission line with different configurations and determine the parameters. CO3:Develop network models of different types of transmission lines and assess their performance. CO4:Analyze and distinguish different distribution system topologies, underground cable grading and earthing types and their basis for selection.
ELECTRICAL MACHINES I	CO1: Sketch and describe the constructional details and operating principles of Transformers and Induction Motors. CO2: Analyze the performance of Transformers and Induction Motors usingphasor diagrams and circuit model of machines. CO3: Select appropriate AC machine for aspecified application and justify the selection.
ELECTRICAL ENERGY SYSTEMS	CO1:Interpret the data available on the nation's energy scenario, distinguish the contributions of conventional and non-conventional sources and co-generation units in power plants. CO2:Describe the operation of different kinds of conventional and non-conventional energy resources and assess their environmental impact and viability in different social situations. CO3:Evaluate various factors that contribute to the economic operation and efficient management of Energy systems. CO4:Compare, choose amongst the various types of substations for a specified location and justify.
DIGITAL SIGNAL PROCESSING	CO1: Apply Discrete Fourier transforms for different types of signals, interpret the information obtained and reconstruct. CO2: Analyze discrete parameter signals and their transforms for their behaviour. CO3: Design and demonstrate application of linear system analysis to engineering problems.
MEASUREMENTS AND INSTRUMENTATION	CO1: Identify& select suitable bridges for the measurement of electrical circuit parameters. CO2: Distinguish the concept behind the operation of analog & digital instruments for the measurement of electrical circuit parameters. CO3: Select and justify the choice of a suitable transducer for an application.
EMBEDDED SYSTEM DESIGN (Department Elective I)	CO1: Design an embedded system as solution to real time problems applying the knowledge of processor, memory and peripheral interfacing techniques. CO2: Analyze schedulers, scheduling algorithms, latencies, task, and synchronization of tasks for real time embedded systems. CO3: Realize a RISC Microcontroller and apply the knowledge of programming to develop small scale embedded applications.
Design and Implementation of Digital	CO1: Apply digital electronics engineering fundamentals to identify, formulate and analyse various digital systems.

Systems using HDL (Department Elective I)	CO2:Design hardware/software systems using appropriate modelling techniques within certain constraints. CO3:Test and interpret the data through experiments using modern IT tools.
C++ for Engineering Applications (Department elective I)	CO1: Apply the basic concepts ofC++ programming in developing the code for various operations CO2:Write C++ programs using salient features of OOPssuch as Classes, Objects, Data Abstraction, Data encapsulation, Overloading, Inheritance,Polymorphism and file handling concepts for various applications. CO3:Develop C++ programs for Electrical and Electronics Engineering applications.
ELECTRICAL INSTALLATION, TESTING, COMMISSIONING AND MAINTENANCE (Department Elective I)	CO1:Apply Indian Electricity Rules and Regulations for design of electrical systems. CO2:Design electrical systems as per the requirements for residential and commercial purposes. CO3:Test and install electrical apparatus and HVAC systems for commercial and industrial applications. CO4: List the conditions for Install of electrical equipment.
	VI Sem
POWER SYSTEMS I	CO1 : Model and analyze power systems using complex mathematical transformations under short circuit and unbalanced conditions. CO2:Analyze different unsymmetrical faults on unloaded alternator and on complex power systems using symmetrical component transformations. CO3: Apply mathematical techniques to evaluate system stability.
ELECTRICAL MACHINES II	CO1: Describe the constructional details, principle of operation, characteristics and speed control of DC machines and select DC motors for specific application. CO2: Evaluate the performance of DC machine by testing them in both generating and motoring modes. CO3: Describe the constructional details, principle of operation of synchronous machine in generating and motoring modes and their selection for specific application CO4: Develop synchronous machine model and evaluate the performance of synchronous machine during parallel operation
Power Electronics – I	CO1: Explain the working , sketch the steady state and dynamic characteristics of power semiconductor devices, types of power converters and their applications, Peripheral effects, and derive relevant expressions for their performance parameters etc. CO2: Formulate equations and estimate circuit components, power loss for given specifications of operation of power devices under steady state and dynamic conditions. CO3: Apply relevant expressions to analyze the performance of power converters.

	CO4: Independently, and in a group study, collate information/data, comprehend a topic related to specific applications of Power Electronics. CO5: Design, simulate and build efficient power conversion systems/subsystems for given specifications for various applications and effectively interpret the results obtained. CO6: Make effective technical presentations on the work carried out and communicate effectively to an audience.
Modern Control Theory	CO1: Create state models using physical variables, mathematical variables and to solve the state equation. CO2: Apply appropriate techniques to analyze the system for its controllability and observability. CO3: Apply relevant concepts to design systems with state feedback to meet the specifications; mathematically represent nonlinear systems and analyze a few simple models.
UTILIZATION OF ELECTRIC POWER (Department elective II)	CO1: Apply the knowledge of mathematics, science and electrical engineering principles to analyze operation different types of electrical heating gadgets such as ovens and welding equipment. CO2: Apply the knowledge of mathematics and electrical engineering principles to design lighting systems for different applications. CO3: Apply the basic knowledge of engineering to analyze the behavior of electrical traction systems under various conditions of operation.
Circuit Design using VLSI (Department Elective II)	CO1: Able to describe and compare various types of VLSI technology. Also understand the methodology of fabrication process. CO2: Apply the knowledge of MOS technology for simple analog/digital circuits. CO3: Use of scaling methods based on various circuit parameters and apply scaling. CO4: To identify the various NMOS and CMOS technology to be used based on their applications and demonstrates the working of a few VLSI circuits
COMMUNICATION SYSTEMS (Department Elective II)	CO1: Acquire basic knowledge of communication systems. CO2 : Characterize and analyze different modulation techniques for analog & digital communication. CO3:Analyze the effect of noise on analog signals.
ELECTRICAL MACHINE DESIGN (Department Elective II)	CO1: Apply the knowledge of fundamental principles, factors electrical engineering materials and use of modern tools for the design of electrical machines. CO2: Apply the general concepts and constraints in design of rotating electrical machines in design of electrical machines. CO3: Design the dimensions of different parts and details of windings of rotating electrical machines CO4: Analyse the effect of dimensions of the different parts of various electrical machines on the output and losses.
DISPLAYS FOR EMBEDDED SYSTEM (Cluster Elective I)	CO1: Understand the working principle behind various display devices for embedded systems. CO2: Apply C programming concepts to program LED and LCDs for embedded displays.

	CO3: Analyse and investigate working of GLCDs for both graphic displays and Touch interfaces. CO4: Work as an individual and thereby conduct experiments using UTLP for a given application/problem statement. CO5: Develop, test, analyze and demonstrate applications of telecommunication using UTLP.
CRYPTOGRAPHY AND NETWORK SECURITY (Cluster Elective I)	CO1: Define, understand and explain concepts related to network security. CO2: Apply the knowledge of communication and coding to telecommunication networks. CO3: Design, implement and analyze algorithms for secure transmission.
BIO-MEMS (Cluster Elective I)	CO1: Apply knowledge of mathematics, science and engineering to understand the working principle of MEMS and sensors, Microfluidic Systems, Bio-Mems. CO2:Identify, analyse and formulate the computing requirement using MOEMS technology, Micro-fabrication techniques. CO3: Understand the environmental impact & safety issues of biomems with reference to medical standards and ethics. CO4: Ability to function, engage in implementing, communicating the concepts and principles learnt in course using soft tool.
Advanced Medical Image Processing (Cluster Elective I)	CO1: Apply knowledge of Mathematics and Engineering to use Morphological operations in image Processing. CO2: Identify and analyze a problem and formulate the computing requirements for segmentation of images. CO3: Implement the processes to detect and recognize an object in the images. CO4: Apply wavelet transform to compress and enhance the quality of images. CO5: Use current techniques and modern tools to improve the image analysis
DATA STRUCTURES AND ALGORITHMS (Cluster Elective I)	CO1: Identify, describe, differentiate and develop the different types of data structures. CO2: Interpret data as arrays and matrices. Develop and Differentiate special matrices. CO3: Understand, develop and create applications using stack and queue structures. CO4: Identify, demonstrate and construct file structures Outline, identify, model and analyze.
PHYSICAL DESIGN (Cluster Elective I)	CO1: Learn the advanced concepts of modern VLSI system design including standard cells, cell libraries, IPs etc. CO2: Partition the system into sub blocks and do floor planning. CO3: Do global placement and detail placement and clock tree synthesis. CO4: Route signals and do physical verification.
PROBABILITY AND RANDOM PROCESS (Cluster Elective I)	CO1: Understand and analyze the concepts of Probability theory. CO2: Understand and analyze the concepts of Random Variables. CO3: Understand and analyze operation on a single random variable. CO4: Understand and analyze the conceptsof Random process.

	CO5: Understand and analyze the Spectral properties of Random process
ADVANCED MICROCONTROLLERS & APPLICATIONS (Cluster Elective I)	CO1: Acquire the knowledge on ARM organization and the feature rich ARM Cortex architecture. CO2: Analyze and apply the instruction set of ARM Cortex processor in developing embedded applications using C & CMSIS. CO3: Recognize the need of firmware, boot- loader, real time operating systems and various communication protocols. CO4: Demonstrate the development of embedded applications using ARM Cortex platforms.
Electrical & Electronics Engineering Materials (Cluster Elective I)	CO1: Understand the physics of equilibrium and kinetics and crystal geometry of engineering materials. CO2: Understand the concept of atomic structure, chemical bonding, and structure of solid. CO3: Apply the principle of physics and mathematics to understand about the properties of conductors, semiconductors, dielectric and magnetic materials. CO4: Apply the concept of conductor, semiconductor, dielectric and magnetic materials to measure properties of these materials.
ELECTROMAGNETIC COMPATIBILITY (Cluster Elective I – Except EC & IT)	CO1: Analyze the fundamentals and reason for noise in Analog electronics, Power Electronicsand Digital electronics circuit. CO2 : Design and development of filters for Analog electronics, Power electronics and Digital circuits for reduction of noise. CO3 : Design the various types of grounding systems and get familiarized with handling electro static discharge systems CO4 : Acquire knowledge about testing standards and regulations.
Modern Control Theory (Cluster Elective I –Except EE)	CO1: Create state models using physical variables ,mathematical variables and to solve the state equation. CO2: Identify appropriate techniques to analyze the system for its controllability and observability. CO3: Apply relevant concepts to design systems with state feedback to meet the specifications, Comprehend mathematical representation of nonlinear systems and analysis of a few simple models.
ROBOTICS (Cluster Elective I)	CO1: Deduce kinematic equations for a given robot configuration. CO2: Select actuators and sensors for specified tasks. CO3: Design and develop manipulators for simple tasks.
INDUSTRIAL INTERNET OF THINGS (Cluster Elective I)	CO1:Understand the building blocks of an IIOT based solution and try applying it to few common problems. CO2: Use one of the ideas of IIOT and propose a solution architecture for the idea in addition to one reference of IIOT in process Automation. CO3: Understand the challenges of IIOT as a technology, understand its strength, limitations. Solve constraints through alternatives to refine the group proposal of process Automation. CO4: Understand concepts of IIOT and apply them in the context of plant operations. Also gain an understanding of the operations of a process plant and identify potential applications.
	VII Sem

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POWER SYSTEMS II	CO1: Apply knowledge of Advanced Mathematics and Electrical Engineering concepts to formulate and solve complex power system problems such as load flow, economic dispatch and load frequency control. CO2: Analyse steady state power system performance based on the load flow model; from the dynamic model of speed governor-turbine system, assess the static performance of the closed loop system. CO3: Investigate the effect of variation of control parameters such as transformer taps, reactive power etc., on the overall power system behavior. CO4: Using optimization techniques, economically schedule the load among all the generators in a power system so that the fuel costs are minimized; as load varies throughout the day, determine the savings in cost. CO5: Write computer programs and/or use standard application software to simulate the power system. Using these modern tools, conduct power flow studies and perform economic dispatch on complex power systems.
SWITCHGEAR AND PROTECTION	CO1: Apply the knowledge to comprehend the need for protective equipment such as fuse and switches. CO2: Identify the components of the relay and circuit breakers to distinguish the parameters affecting their operation. CO3: Comprehend the working of static relays and comparators. CO4: Conduct relevant experiments to investigate the performance of switch gear under different situations.
POWER ELECTRONICS -II	CO1: Analyse the performance of basic DC – DC, derived and resonant converters. CO2: Carry out simulations of basic DC – DC converters in CCM/DCM mode and derived converters. CO3: Conduct experiments to validate the performance of basic DC – DC converters in CCM/DCM mode and derived converters. CO4: Design magnetic components of a circuit using basic concepts of magnetic circuits. CO5: Apply the concepts of microcomputer control for power electronic system.
HIGH VOLTAGE ENGINEERING (Department Elective - III)	CO1: Apply the knowledge to comprehend Generation of High Voltage CO2: Apply the knowledge to identify suitable dielectrics in various HV applications. CO3: Analyse the Breakdown Phenomenon in Insulators CO4: Analyse the factors affecting HVAC & HVDC measurements CO5: Conduct experiments on Solids, Liquids (conventional & bio-friendly) to assess the dielectric behavior under power frequency and high frequencies
ELECTRICAL POWER QUALITY (Department Elective - III)	CO1: Explain the issues and concerns of power quality, classify ,sketch and identify various power quality phenomena normal as well as abnormal, define several standards related to power quality, the effect of distributed generation ,origin of power quality variations, consequences

	and effect of frequency variations, effects of harmonic distortions, explain the working of instruments and mitigation methods used for PQ problems. CO2: Apply the concepts to evaluate power system quantities for systems under specified sinusoidal and non sinusoidal conditions of operation. CO3: Analyze behaviour of systems and interpret data presented through case studies for power quality issues and suggest suitable remedial measures. CO4: Independently and/or in a group design experiments, model, simulate, measure using specialized equipment, study, collate information/data ,on loads that cause power quality problems in different field set-ups such as domestic /bulk consumers of electricity. CO5: Make effective technical presentations and reports on the work carried out and communicate effectively to an audience.
CONTROL OF ELECTRICAL DRIVES (Department Elective III)	CO1: Apply the fundamental concept to comprehend the working of industrial Drives and dynamics. CO2: Apply the knowledge to select appropriate motor for the specified application to meet customer requirements. CO3 : Analyse the performance of dc motor drives for various operating condition. CO4: Analyse the performance of induction motor during unbalanced condition, control of induction motors with the help of power electronic circuits.
COMPUTER COMMUNICATION AND NETWORKING FOR ELECTRICAL ENGINEERING APPLICATIONS (Department Elective – III)	CO1. Acquire knowledge about network models, devices ,principles of communication, current technology and associated IEEE communication standards for wired and wireless communication. CO2. Analyse the services provided by various layers of network models, protocols of Data Link Layer, Transport layer. Co3. Implement network protocols for a given network topology using modern tools. CO4. Apply communication and networking concepts for electrical engineering.
SOLAR AND WIND ENERGY CONVERSION SYSTEMS (Cluster Elective II)	CO1: Understand current strategies, plan and policies of GOI in Renewable energy usage and awareness about sustainable development. CO2: Understand the methods and opportunities for energy conservation in Industrial and Domestic sectors and its impact on the environment. CO3: Apply the knowledge of mathematics and physics to analyse the solar radiation, its measurement also to estimate wind power. CO4: Explain the Energy Conversion with respect to Solar- Thermal, PV and Wind applications.
PLC AND SCADA (Cluster Elective II)	CO1: Memories the basic concepts of use of computers in process control through data loggers, DAS, SCADA, DDC and DCS. CO2: Understanding and implementation of ladder programming for various applications using PLCs. CO3: Illustrate the various parts of distributed control systems and its application in industry. CO4: Classify various industrial communication protocols used in PLC's and DCS network.

Electrical Power and Energy Management Systems (Institutional Elective- I)	CO1: Apply the knowledge and try to solve the problems of power crisis in India by analyzing different load availability with respect to requirements and demands. CO2: Select and apply different methods of tariffs used in practice and to motivate and apply the energy conservation methods in various sectors of energy use. CO3: Analyze various energy auditing methods to conserve energy in various sectors. Co4: Analyze different load curves of various energy sectors and apply load control methods for optimal use of electricity.
MICRO & SMART SYSTEM (Institutional elective –I)	CO1: Develop and understand the concept about micro systems, their working and applications as sensors and actuators. CO2: Analyze the complexity of fabrication process and micro machining technologies. CO3: Understand the design of different electronic circuits and components used in micro sensors & actuators. CO4: Develop knowledge about integration, interconnection & packaging of microsystems leading to a suitable societal engineering solution.
PROJECT FOR COMMUNITY SERVICE	CO1: Do a survey and formulate a problem identified. CO2: Apply a suitable engineering/IT tool for modeling/data interpretation/analysis, conduct experiments leading to a logical solution of the proposed problem. CO3: Compare the proposed solution with other available alternatives. CO4: Communicate effectively to diverse audience trough presentations and develop technical reports and publications.
	VIII Sem
SUSTAINABLE PRACTICES IN ELECTRICAL ENGINEERING	CO1: Comprehend the design and challenges in LV distribution systems, selection of various switch gears for LV distribution, Robust design Issues in Switch Gears & Protection of LV distribution, Various Quality control methodsfor robust products. CO2: Analyzethe performance of electrical systems that exist for societal use for safety, sustainability, energy efficiency, quality, economics and reliability. CO3: Apply ethical knowledge /standard practices to assess the extent of adherence to regulations in electrical products. CO4: Make effective reports/presentations on various aspects of the studies carried out.
PROJECT MANAGEMENT AND FINANCE	CO1: Apply the Knowledge of project management principles and to implement project management methodologies required for successful project completion. CO2: Develop Ethical principles in project planning and execution as a team and documentation in project implementation. CO3: Identify and Apply finance aspects for project implantation in time. CO4: Use modern tools to simulate their respective projects and case studies and investigate the behaviour under various operating conditions.

INTELLECTUAL PROPERTYRIGHTS AND CYBER LAW	CO1: Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks CO2: Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context CO3: Ability to use IPRs and Cyber Law to access societal, health, safety & Cultural issues CO4: Ability to work in multiple teams to effectively communicate IP & Cyber Law.
OPERATIONS RESEARCH (Institutional Elective- II)	CO1: Formulate a real-world problem as a mathematical programming model. CO2: Formulate and solve transportation models by applying cost cutting strategies. CO3: Formulate and solve assignment models and travelling salesmen problems. CO4: Construct a project network and apply program evaluation review technique and critical path management. CO5: Employ Game theory for strategic decision making
MAJOR PROJECT	CO1: Ability to research literature, and formulate a complex engineering problem. CO2: Apply the fundamental knowledge of mathematics, science and engineering principles in design of solutions of system components. CO3: Identify, Select, and Apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, conduct experiments leading to a logical solution. CO4: Design a system/ system component/process, build it and test its functioning as a solution to a complex engineering problem. CO5: Communicate effectively to a diverse audience and develop technical reports and publications.
SEMINAR	CO1: Analyze and interpret data for complex systems. CO2: Select and apply modern engineering tools CO3: Communicate Effectively to an Audience, and design documentation (written graphical and visual forms) CO4: Engage in independent learning
Name of the Programme	**M.Tech in Power Electronics**
Programme Educational Objectives (PEOs)	1. Excel professionally in Power Electronics and allied domains. 2. Undertake research and development that addresses technological requirements of Industry and Institutes of higher learning 3. Adapt to the changing needs of Industry/Society through lifelong learning.
Programme Outcomes (POs)	1. An ability to independently carry out research /investigation and development work to solve practical problems. 2. Ability to write and present a substantial technical report/document.

	3. Students should be able to demonstrate a degree of mastery over the areas per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
Course Outcomes (COs)	The COs for all the courses offered - Core and electives
Course Name	**Course Outcomes**
	I Sem
APPLIED MATHEMATICS	CO1: Apply the concepts of solving polynomial equations, transcendental equations, ordinary differential equations, partial differential equations, system of algebraic equations, non-linear equations, and ordinary differential equations for Engineering problems. CO2: Apply the concepts of graph theory, eigen value problems, interpolation and linear algebra to deal with projects.
POWER SEMICONDUCTOR DEVICES	CO1: Apply knowledge of physics of semiconductor and electronic devices to develop and control power electronic systems. CO2: Describe, analyze characteristics and compare various types of power semiconductor devices for theoretical and practical context. CO3: Identify and prioritize the use of power devices in various power electronic systems and control applications. CO4: Apply the concept of thermal design for various power electronic equipment's. CO5: Develop skills and apply the principles to explore the possibility of emerging power semiconductor devices in different areas and prepare a technical report
SOLID STATE POWER CONTROLLERS	CO1: Analyze the performance of single phase and three phase AC- DC converters in all the modes of operation. CO2: Analyze the performance of single phase and three phase inverters and evaluate. CO3: Analyze and evaluate different PWM schemes for voltage control and harmonic reduction in inverters. CO4: Conduct performance analysis of different choppers. CO5: Conduct experiment / simulation studies on single phase and three phase power electronic converters and write a report.
MODELING AND SIMULATION OF POWER ELECTRONIC SYSTEMS	CO1: Apply mathematical skills and modelling methods to represent a physical system. CO2: Design and develop digital controllers to control Power Electronics systems parameters. CO3: Develop various Power Electronics circuits using modern engineering software tools and prepare a technical report. CO4: Analyze performance of various Power Electronics circuits.
DIGITAL MEASUREMENTS (Elective)	CO1: Realize the significance of digital based measurements using Microprocessor/Microcontroller. CO2: Analyze time and frequency measurement techniques and apply the knowledge for the design of various circuits. CO3: Realize and design different D/A converters. CO4: Design A/D converters and apply the concept of voltage measurement technique for various systems.

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MODELING AND ANALYSIS OF ELECTRICAL MACHINES (Elective)	CO1: Apply basic concepts of modeling for DC Machines, three phase induction machine and synchronous machines. CO2: Model a single phase & three phase transformers, autotransformers and transmission line. CO3: Carry out the dynamic performance analysis of synchronous machines.
POWER ELCTRONICS IN SMART GRID (Elective)	CO1: Acquire in-depth knowledge of Smart Grid, distributed generation, Electro Magnetic Compatibility (EMC) in power system, high frequency AC power distribution platforms and analyze power quality problems in an electricity network. CO2: Apply the concept of distributed generation and solve the problem of its integration with the existing power system network. CO3: Learn and explain in the form of presentation and report about different active power controllers used in different places of power system network. CO4: Analyse the importance of different energy storage systems in the smart grid concept of complex power system.
EMBEDDED SYSTEM DESIGN (Elective)	CO1: Apply the basic concepts and design an embedded system for real time applications. CO2: Analyze different techniques to provide solutions for practical problems. CO3: Evaluate and select a high performance processor to develop a real time system. CO4: Present and prepare a technical report for a specific real time embedded system.
CMOS VLSI DESIGN AND SYSTEM ON CHIP (Elective)	CO1: Apply the basics of CMOS technology and its characterization and performance Estimation. CO2: Analyze the design strategies and testing methods for CMOS sub-systems. CO3: Identify various SoC design structures. CO4: Realize SoC system design models in computation, co design and prepare a technical report.
ADVANCED CONTROL SYSTEM (Elective)	CO1: Create state models for continuous and discrete time systems. CO2: Identify appropriate techniques to analyze both continuous and discrete systems for controllability and observability CO3: Apply relevant concepts to design continuous and discrete systems with state feedback to meet the specifications.
RESEARCH METHODOLOGY & IPR (INSTITUTION CORE COURSE)	CO1: Able to write and present a substantial technical report/document CO2: Able to demonstrate a degree of mastery over the area of specialization
	II Sem
AC AND DC DRIVES	CO1: Analyze AC-DC Drives circuits critically, in a wider theoretical context. CO2: Evaluate and choose the appropriate converter topology for different AC-DC drives circuits. CO3: Develop simulation models for AC-DC drives systems prescribed in the curriculum.

	CO4: Apply appropriate techniques, design and tools, to conduct experiments, compare and analyze the hardware results with that of simulation results and prepare a technical report.
SWITCHED MODE POWER CONVERSION	CO1: Analyze the performance of basic converters for CCM and DCM operation. CO2: Carry out the performance analysis of derived converters and evaluate. CO3: Analyse the dynamic response of converter using state space averaging and design controller. CO4: Apply the concept of resonant converters and conduct performance studies of different resonant converters. CO5: Conduct experiment/simulation studies on basic converters and derived converters for CCM/DCM operation and prepare a technical report. CO6: Design magnetic components for high frequency SMPS and submit a report.
FACTSCONTROLLERS IN POWER TRANSMISSION AND DISTRIBUTION	CO1: Model and analyze the AC transmission lines with and without the FACTS controllers. CO2: Design controllers for various FACTS controllers. CO3: Analyze the performance of FACTS controllers. CO4: Carry out simulation/activities on FACTS controllers and prepare technical reports.
POWER ELECTRONICS SYSTEM DESIGN USING ICs (Elective)	CO1: Analyze power electronic systems using ICs. CO2: Design high performance power electronic circuits using different ICs for various applications. CO3: Design a Power Electronic System using Microcomputer and DSP Control. CO4: Analyze the performance of a Power Plant using Programmable Logic Controller. CO5: Think laterally and originally to solve power electronic circuits, and evaluate problems for Practical switching power supplies and prepare a report.
HVDC TRANSMISSION SYSTEMS (Elective)	CO1: Justify the application of AC or HVDC transmission systems based on the power transmission scenario such as quantum of power to be transferred, economics, reliability factors, etc. CO2: Model HVDC transmission systems. CO3: Analyze the HVDC transmission systems. CO4: Design various controllers and filters for HVDC systems.
PWM CONVERTERS AND APPLICATIONS (Elective)	CO1: Develop and analyze various PWM Techniques for converters. CO2: Analyze & estimate the various losses in converters. CO3: Model the PWM Converters and Induction motor drives. CO4: Apply various compensation techniques for the converters.
POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES (Elective)	CO1: Analyze the Power quality issues and concerns of the country. CO2: Identify the type of Power quality problems with reference to IEEE/IET standards. CO3: Analyze, evaluate and realize the control techniques for power quality problems.

	CO4: Decide on choosing the necessary monitoring equipment and mitigation techniques.
ELECTRO MAGNETIC COMPATIBILITY (Elective)	CO1: Analyse the fundamentals and reasons for noise in Analog electronics, Power electronics and Digital electronics circuit. CO2: Design and develop filters for Analog electronics, Power electronics and Digital circuits for reduction of noise. CO3: Design the various types of grounding systems and get familiarised with handling electro static discharge systems, testing standards and Regulations. CO4: Acquire knowledge about testing standards and regulations.
ELECTRIC VEHICLES (Elective)	CO1: Acquire in depth knowledge of the electric vehicle system and its components and various modes of operation. CO2: Estimate and analyze the performance parameters including energy consumption, tractive effort etc. associated with an electric vehicle under different conditions of operation and also various types of electric drive systems suitable for electric vehicle operation. CO3: Design a battery operated electric vehicle for a given specification. CO4: Prepare and present a technical report on modeling and operation of Electric vehicles.
RENEWABLE ENERGY & PHOTOVOLTAICS (Institutional Elective)	CO1: Acquire in depth knowledge about different types of renewable & non-renewable sources and the physics of photovoltaic system. CO2: Apply knowledge of mathematics to solve problems related to solar radiation & measurement, basic sun earth angles, and cell characterization. CO3: Analyze the concept of MPPT Algorithms, economic aspects of PV systems and design of charge controllers. CO4: Design and model PV cells & modules for roof top and grid connected systems and analyze the issues related to grid integration, interfacing and power quality.
MICRO & SMART SYSTEMS (Institutional Elective)	CO1: Acquire in depth concept of micromachining technologies namely vacuum pump, deposition techniques and lithography and acquire knowledge about integration of microsystem. CO2: Apply the knowledge of applied physics to know the principle of operations of different sensors & actuators. CO3: Analyze mode of operation of different characterization techniques like SEM, XRD and TEM and further analyze different electronic circuits to control micro systems. CO4: Prepare and present a technical report on effects of scaling in different domain in Micro Systems
	III Sem
INTERNSHIP	CO1: Get an insight into the company profile and understand the organizational structure. CO2: Apply and correlate theory and practice. CO3: Communicate effectively regarding complex Engineering activities. CO4: Demonstrate knowledge and understanding of Engineering & Management principles of the company.

	CO5: Engage in life-long learning with a commitment to improve knowledge and competence continuously. CO6 : Acquire professional & intellectual integrity and its impact on the society. CO7 : Observe and examine critically and make corrections cautiously.
PROJECT WORK (I-PHASE)	CO1: Carry out literature survey, and formulate a complex engineering problem. CO2: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components. CO3: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, conduct experiments leading to a logical solution. CO4: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem. CO5: Communicate effectively the work carried out before the expert committee.
	IV Sem
PROJECT WORK (FINAL PHASE)	CO1: Carry out literature survey, and formulate a complex engineering problem. CO2: Apply the fundamental knowledge of mathematics, engineering and Power Electronics principles in design of solutions or system components CO3: Identify, Select, and apply a suitable engineering/IT tool in modeling/data interpretation /analytical studies, conduct experiments leading to a logical solution. CO4: Design a system/system component, simulate and test its functioning as a solution to a complex engineering problem. CO5: Develop a prototype model for the project work CO6 : Develop good technical reports and publications in reputed conferences / journals based on project work results. CO7 : Communicate effectively the work carried out before the expert committee. CO8: Manage project work in the core Power Electronics domain within the stipulated time.
TECHNICAL SEMINAR	CO1: Carryout literature survey, and choose a relevant topic reported in recent IEEE conference publications / transactions in the domain of Power Electronics. CO2: Simulate and analyze the results reported in the chosen paper for seminar topic. CO3: Communicate effectively before the expert panel and develop technical reports. CO4: Respond to the queries raised by the evaluation committee and audience

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Academic Year 2019-20

Name of the Programme	B.E. in Electronics & Communication Engineering
Programme Specific Outcomes (PSOs)	1. Analyse and design electronic systems for signal processing and communication applications. 2. Demonstrate the Conceptual domain Knowledge with respect to Architecture, Design, Analysis and Engineering deployment in Data communication and Computer networking. 3. Identify and apply domain specific tools for design, analysis, synthesis and validation of VLSI and Communication systems.
Programme Outcomes (POs)	PO1 to PO12 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. 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. 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. 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. 10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. 11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one"s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. 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. 13.
Course Outcomes (COs)	**2019-20**

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I sem / II Sem	
SUBJECT	**Course Outcome**
ELEMENTS OF ELECTRONICS ENGINEERING	CO1: Understand the Concepts of Electronic Devices and Circuits and realize the Applications of Electronics in Interdisciplinary Engineering Domains.
18EC1ICEEE/18EC2ICEEE	CO2: Apply the basic principles of Electronics to solve Analog and Digital circuits.
	CO3: Analyze the characteristics/performance parameters of Electronic Circuits.
	CO4: Design basic Electronic Circuits for given Specifications.

III SEM		
19MA3BSEM3 ENGINEERING MATHEMATICS – III	CO 1	Apply Numerical techniques to solve problems arising in engineering.
	CO 2	Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.
	CO 3	Apply the concepts of calculus to functionals.
19ES3CCECA ELECTRICAL CIRCUIT ANALYSIS	CO1	Formulate equations based on physical laws and analyze the steady state behaviour of complex electric networks.
	CO2	Apply the knowledge of mathematics and graph theory to the solution of complex electrical networks.
	CO3	Apply mathematical and analytical techniques to analyze transient behaviour of networks.
	CO4	Analyze networks based on two port networks and Unbalanced three-phase load.
19ES3CCAEC ANALOG ELECTRONIC CIRCUITS	CO1	Define, understand and explain concepts related to diodes and transistors (BJTs and MOSFETs)
	CO2	Apply the knowledge of network theorems and device models to solve given analog electronic circuits
	CO3	Analyze a given analog electronic circuits to compute required parameters
	CO4	Design analog electronic circuits for a given specification
	CO5	Conduct experiments to demonstrate the knowledge of design and analysis using circuit simulators/hardware.

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19ES3CCDEC DIGITAL ELECTRONIC CIRCUITS	CO-1	Understand the fundamental logic functions and Basic Building blocks of Digital Logic design
	CO-2	Analyse and Realise logic functions by choosing the suitable logic blocks
	CO-3	Optimize the logic circuit with cost effective solution
	CO-4	Design a complete digital circuit for given problem statement by applying the digital circuit concepts
	CO-5	Conduct experiments using digital ICs to demonstrate a given application/ problem statement.
19ES3GCFTH FIELD THEORY	CO-1	Apply the laws of static Electric & Magnetic fields to study Time-varying electro-magnetic fields and Waves
	CO-2	Analyze and solve Electromagnetic problems related to static/time varying fields and also wave propagation in different media
	CO-3	Self-learning through listening and comprehension of audio / video lectures related to electro-magnetic fields and waves domain
19EC3DCMSA MODERN SENSORS AND ITS APPLICATIONS	CO-1	Understand sensor fabrication and characterization techniques
	CO-2	Apply the concepts of physics to understand the principle of sensing physical parameters
	CO-3	Analyze the working of analog sensors for engineering applications
19EC3PWMP1 MINI PROJECT I	CO-1	Analyze, design and develop solutions to real-world problems applying the fundamental concepts of electronics learnt from previous and current semesters
	CO-2	Work in a team and Explore the open source tools and resources in solving the problems
19IC3HSCPH CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS	CO1	Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land.
	CO2	Analyse the concepts and ideas of Human Rights.
	CO3	Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
19MA3IMMAT Additional Mathematics-I	CO1	Understand the basic concepts of differentiation and integration.
	CO2	Apply the concepts of polar curves and multivariate calculus.

	CO3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.
	CO4	Apply techniques of vector calculus to engineering problems.
	CO5	Comprehend the generalization of vector calculus in curvilinear coordinate system.

IV SEM		
19MA4BSEM4 ENGINEERING MATHEMATICS –IV	CO1	Understand the basic concepts of differentiation and integration.
	CO2	Apply the concepts of polar curves and multivariate calculus.
	CO3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.
	CO4	Apply techniques of vector calculus to engineering problems.
	CO5	Comprehend the generalization of vector calculus in curvilinear coordinate system.
19ES4ESCST CONTROL SYSTEMS	CO-1	Apply the knowledge of engineering fundamentals to form mathematical model and obtain transfer function/state space representation of a system.
	CO-2	Design LTI systems for given time/frequency domain specifications using different techniques.
	CO-3	Analyse the stability of LTI systems in time/frequency domain using different techniques
19ES4CCLIC LINEAR INTEGRATEDCIRCUITS	CO-1	Define, understand and explain the DC and AC performance characteristics of op-amp, applications of op-amp, working of 555 timer and voltage regulators.
	CO-2	Apply the knowledge of KVL and KCL to obtain voltage/current/waveforms at different points in analog electronic circuits such as op-amp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators,555 timers.
	CO-3	Analyseanalog electronic circuits such as op-amp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators,555 timers

	CO-4	Design analog electronic circuits such as op-amp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators,555 timers
	CO-5	Conduct experiments using analog electronic components, electronic instruments to function as amplifiers, comparators, rectifiers, filters, astable and monostable circuits using 555 timer, data converters.
	CO-6	Engage in self-study/independent study to formulate, design, implement, analyse and demonstrate an application using analog electronic components/SIM tools through a mini project
19ES4CCMCS MICROCONTROLLERS	CO-1	Understand and explain architecture of microprocessors and microcontrollers, pipelining, addressing modes, data types in Embedded C, serial communication, timer configuration, interrupt handling of microcontroller, and memory expansion.
	CO-2	Apply the knowledge of addressing modes and instructions to develop 8051 assembly programs.
	CO-3	Analyse the code in assembly / Embedded C for applications of the timer, serial communication and interrupts of 8051
	CO-4	Design an 8051 system by interfacing 8051 to external memory , I/O, peripheral devices and external devices.
	CO-5	Conduct experiments by simulating assembly and Embedded C code using KEIL IDE and interfacing the hardware modules to 8051 platform
19ES4CCSAS SIGNALS AND SYSTEMS	CO-1	Knowledge of mathematical representation of signals and systems in various domains.
	CO-2	Apply various properties of transform techniques to solve the continuous and discrete Linear Time Invariant Systems
	CO-3	Analyze various methods to categorize the LTI Systems and identify solutions for mathematical representation of systems.
19EC4PCHDL HDL PROGRAMMING	CO-1	Apply the knowledge of HDL for modeling and functional verification of Digital circuits.
	CO-2	Analyze digital circuits using suitable Verliog HDL modeling
	CO-3	Design and synthesize a digital circuit for complex systems using Verilog HDL and state machines

	CO-4	Program and synthesize a given application/problem statement using EDA tools
19HS4PCEVS ENVIRONMENTAL STUDIES	CO-1	Understand the components and impacts of human activities on environment.
	CO-2	Apply the environmental concepts for conservation and protection of natural resources.
	CO-3	Identify and establish relationship between social, economical and ethical values from environmental perspectives.
19MA4IMMAT Additional Mathematics-II	CO1	Describe the operating principles and characteristics of Transformers and Induction Motors.
	CO2	Analyze the operation of Transformers and Induction Motors using phasor diagrams and circuit model of machines
	CO3	Describe the methods of testing and estimate performance of Transformers and Inductionmotors

V Sem	
Communication Theory - 1	CO1: Apply various concepts of theorems and Transforms for computing parameters of Communication systems
16EC5DCCT1	CO2: Analyze performance of different types of Analog modulation Techniques for a given set of parameters
	CO3: Design Analog Communication subsystems for given set of specifications
	CO4: Simulate and conduct experiments on different types of Analog communication subsystems
	CO5: Involve in independent/team learning, Communicate effectively and engage in life-long learning
Digital Signal Processing	CO1: Apply the concepts of transform techniques in realizing Discrete time signal and Digital filters
16EC5DCDSP	CO2: Analyze various transform techniques for discrete time signals and various methods to design digital Filter
	CO3: Design of Analog and Digital Filters for given specifications.
	CO4: Simulation and verification of various transform techniques and filter Design
	CO5: Engage in self-study to design and demonstrate an application of digital signal processing

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Fundamentals of VLSI	CO1: To Apply the knowledge of CMOS technology to construct basic and advanced CMOS logic circuit like memory & array subsystems
16EC5DCFOV	CO2: Analyse the ideal & non ideal IV effects of MOSFET and DC transfer characteristics CMOS circuit
	CO3: Design of CMOS based combinational and sequential circuits for given specification
Microwave Engineering	CO1: Apply concepts of Fields and Networks to study working principles of specific microwave active/passive devices, transmission lines/microwave devices
16EC5DCMWE	CO2: Analyze microwave networks and components using S-parameters
	CO3: Gain knowledge on effect of microwaves on human body , impact of the professional engineering solutions on environment and society and the consequent responsibilities relevant to an EC engineer
Control System	CO1: Understand Basic control systems and applying different techniques to reduce system and determine stability.
16EC5DCCSM	CO2: Analyzing system performance and stability using different approaches.
	CO3: Evaluation of system performance by varying system parameters of the control systems.
	CO4: Create, Apply and analyze control system problems using MATLAB or Simulink tool
OOPs using C++	CO1: Apply knowledge of object-oriented concepts to implement a given problem statement.
16EC5DE1OP	CO2: Design and analyze solution to a given problem using C++.
	CO3: Simulate and document the given application using Object Oriented approach.
Advanced Digital Logic Design	CO1: Apply the concepts of Digital design to create digital building blocks using Verilog.
16EC5DE1AL	CO2: Analyze the RTL timing to report violations and synthesize to generate gate level netlist.
	CO3: Design of RTL using finite state machines along with design optimization.

	CO4: Simulate and debug the design using test benches and analyze the synthesis timing and power reports.
Image Processing	CO1: Apply enhancement and restoration techniques to 2D images in spatial and frequency domain for required visualization.
16EC5DE1IP	CO2: Analyze and represent an image using transform techniques in different domains.
	CO3: Interpret image in various data formats by applying image transformation / processing techniques for different applications.

VI Sem	
Communication Theory - 2	CO1: Apply the knowledge of various signal processing and coding techniques for effective communication in digital systems
16EC6DCCT2	CO2: Analyze the performance of a given digital communication system
	CO3: Design a digital communication system for a given set of specifications.
	CO4: Conduct experiments / simulate to demonstrate a given application / problem statement in digital communication
	CO5: Engage in self-learning of advanced concepts and application of Digital Communication
Mixed Signal Design	CO1: Apply the knowledge of basic CMOS technology to understand and explain the concepts of analog integrated circuits and mixed signal circuits
16EC6DCMSD	CO2: Analyze CMOS based Analog, ADC and DAC circuits
	CO3: Design analog CMOS integrated circuits and mixed signal circuits
	CO4: Conduct experiments on Analog and mixed signal CMOS circuits using modern EDA tools
	CO5: Engage in self learning to design and demonstrate an application using CMOS based mixed signal circuits
Computer Communication Networks	CO1: Apply the concepts of Computer Networks and Networks Models for Data Communication.

16EC6DCCCN	CO2: Analyze networking architecture and infrastructure for wired and wireless link.
	CO3: Skill to substantiate design and performance issues in LANs for a given specification.
	CO4: Ability to submit a report on the impact/growth of wired and wireless network for societal and sustained development.
Antenna and Wave Propogation	CO1: Apply the concepts & properties of Electro-Magnetism to obtain parameters of antennas and Wave Propagation
16EC6DCAWP	CO2: Analyze different types of antennas, characteristics of radio-waves and their propagation in the atmosphere
	CO3: Effectively prepare and present a seminar/case study on assigned topics related to Advanced topics/Safety measures/antenna design as an individual/team
Advanced Digital Logic Verification	CO1: Apply the knowledge of OOPs concepts, system Verilog constructs and data types to create verification environment
16EC6DE2LV	CO2: Analyze coverage driven verification for given design under test(DUT)
	CO3: Design solutions to obtain 100% code coverage and functional coverage by determining the set of input constraints and assertions in test benches.
	CO4: Simulate the layered test bench architecture using system Verilog and analyze coverage reports
Operating Systems	CO1: Apply the knowledge of different classes and structure of operating system and requirement of system protection.
16EC6DE2OS	CO2: Analyze the scheduling, page replacement policies for the process requirement, memory management in an operating system
	CO3: Analyze the device management and identify need for operating systems in the field of communication and computer networks and pursue life-long learning in it.
Data Structures and Algorithm	CO1: Apply programming concepts to realize various data structures

16EC6GE1DA	CO2: Analyze the suitability of a given data structure for a given application
	CO3: Develop a data structure for a given application/s
Sensor Technology	CO1: Apply the concepts of physics to understand the principle of sensing physical parameters
16EC6GE1ST	CO2: Analyze the working of analog and digital transducers in engineering applications
Advanced Microcontrollers and Applications	CO1: Apply the acquired knowledge on ARM7 and ARM Cortex m3 architecture, their features and instruction set in programming the ARM processor.
16EC6GE1AM	CO2: Analyze the architectural features of ARM7 and Cortex M3, concepts on system software and communication protocols to design ARM based embedded applications.
	CO3: Design and develop ARM based embedded applications.
VII Sem	
Data Communication Networks	CO1: Apply the concepts of Networks layer protocols to deliver packets across Multiple Networks (links).
16EC7DCDCN	CO2: Analyze issues of routing and congestion mechanism for independent and internetworking networks for wired and wireless link.
	CO3: Design, calculate, and apply subnet masks and routing addresses to fulfill networking requirements.
	CO4: Create Network for given specification and conduct experiments within a simulated networking environment.
	CO5: Involve in independent learning on contemporary issues in networking technologies, Communicate effectively and prepare a report.
Embedded System Design	CO1: Apply the embedded system models, features of processors, memory and I/O systems in developing embedded System.
16EC7DCESD	CO2: Analyze the embedded OS functionality and device drivers used in multitasking embedded applications.
	CO3: Design embedded applications using given specifications and concepts of development process.

	CO4: Demonstrate practical experiments on developing embedded systems.
	CO5: Engage in self learning in analyzing and carrying out embedded projects.
Power Electronics	CO1: Apply basic circuit theory concepts to solve Power and control circuits in power electronics domain
16EC7DCPEL	CO2: Identify and Analyze power electronics circuits for a given task/application and draw valid conclusions with suitable assumptions
	CO1: Design solutions to meet the given specifications of controlled rectifiers, dc-dc converters, inverters and few basic triggering circuits
	CO2: Conduct experiments & carry out data interpretation on power electronic circuits with valid conclusions and individually / in a team to prepare a report and make an effective presentation.
Project for Communicty Service	CO1: Ability to apply knowledge to identify, gather information and analyse to formulate the problem definition for project through detailed investigation.
16EC7DCPW1	CO2: Ability to use appropriate tool/tools to implement and demonstrate the defined project.
	CO3: Ability to design and develop sustainable solution/system for the betterment of the society.
	CO4: Ability to make effective presentation of the work with professional ethics as an individual or a member of a team.
	CO5: Ability to develop sustainable system with scope for enhancement and continue life-long learning.
Internet of Things	CO1: Apply the Knowledge of architecture, algorithms and schemes in Internet of things from a global context
16EC7GE2IT	CO2: Analyze the data base using efficient Algorithms
	CO3: Design protocols and test on scenarios for improving effective implementation of IOT
	CO4: Implement IOT applications and open source platform for data analytics
Multimedia Communication	CO1: Apply the basic communication knowledge on multimedia with applications

16EC7GE2MC	CO2: Analyze various data compression techniques and algorithms for audio and video systems
	CO3: Explore different multimedia concepts applied to internet
Computer Vision	CO1: Apply various segmentation, feature extraction and representation techniques for a give pattern analysis problem
16EI7GE2CV	CO2: Analyse various pattern recognition and classification schemes to perform a specific computer vision task
	CO3: Design 3D visualization models to process a 3D object and perform a specific computer vision task
Network Security & Cryptography	CO1: Apply the knowledge of encryption and security techniques along with cyber forensics to fulfil the societal needs
16EC7DE3NS	CO2: Analyse the different types of encipherment techniques along with key exchange mechanisms.
System on Chip	CO1: Apply concepts of Moores law, CMOS scaling to understand the System on Chip with its need, evolution, challenges, goals, superiority over system on board & stacked ICs in package.
16EC7DE3SC	CO2: Analyze Typical goals in SoC design and also inter connect architecture
	CO3: Design solutions for issues at system level, and issues of Hardware-Software co design
Low Power VLSI	CO1: Apply the concept of power analysis in simulators at different levels of design abstraction.
16EC7DE3LV	CO2: Analyze power dissipation using mathematical and probabilistic approach in digital logic cells and compare the various clock tree synthesis methods. The
	CO3: Determine various circuit techniques for low power logic cells.
Fundamentals of Mobile Communication	CO1: Acquire the knowledge of mobile communications fundamental and standards, GSM, GPRS and 3G systems. And apply this concepts in solving fundamental traffic problems

16EC7IE1MC	CO2: Investigate on m commerce life cycle, financial services, entertainment services, - content development and distribution and caching, through literature survey and use cases

VIII Sem	
intellectual Property Rights & Cyber Law	CO1: Ability to understand and commit to professional ethics and responsibilities to obtain Intellectual property Rights like Patents, Copyright & Trademarks
16HS8GCIPL	CO2: Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the societal and environmental context
	CO3: Ability to use IPRs and Cyber Law to access societal, health, safety & Cultural issues
	CO4: Ability to work in multiple teams to effectively communicate IP & Cyber Law.
Project Management & Finance	CO1: Apply the Knowledge of project management principles and to implement project management methodologies required for successful project completion
16HS8GCPMF	CO2: Develop Ethical principles in project planning and execution as a team and documentation in project implementation
	CO3: Identify and Apply finance aspects for project implantation in time
	CO4: Use modern tools to simulate their respective projects, case studies and investigate the behaviour under various operating conditions.
Electronics & Communication for Sustainable Development	CO1: Apply the concepts of Electronics and Communication Engineering to solve societal issues
16EC8DCECS	CO2: Review and analyse the performance of the Electronic system for the specific societal issues.
	CO3: Able to identify and develop process that meets specified needs with appropriate considerations for environment Understand the impact of Electronics & communication Engineering for the sustainable development

	CO4: Develop awareness about current global and contemporary issues in technology and science and skills to be life-long learners
Internship/Technical Seminal	CO1: Investigate some of the current scientific trends/issues facing society
16EC8DCSMR	CO2: Practice skills that are necessary for any engineer/academic learner
Major Project	CO1: Ability to apply knowledge to identify, gather information and analyse to formulate the problem definition for project through detailed investigation.
16EC8DCMPJ	CO2: Ability to use appropriate tool/tools to implement and demonstrate the defined project.
	CO3: Ability to design and develop sustainable solution/system for the betterment of the society.
	CO4: Ability to make effective presentation of the work with professional ethics as an individual or a member of a team.
	CO5: Ability to develop sustainable system with scope for enhancement and continue life-long learning.
Automotive Electronics	CO1: Apply the knowledge of engineering and science to analyze the performance of Electronic Engine Control, working of sensors and actuators
16EC8IE2AE	CO2: Analyze the vehicle level Electronic Control for automotive subsystems.
	CO3: Gain insight about building future automotive subsystems that contributes to the safety and health of the society using block diagram approach

Course Outcomes (COs)	
Name of the Programme	MTech – Electronics
Programme Educational Objectives (PEOs)	
Programme Outcomes (POs)	PO1: An ability to independently carry out research /investigation and development work to solve practical problems PO2: Ability to write and present a substantial technical

	report/document PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Course Outcomes (COs)	2019-20	
MTECH ELECTRONICS		
2019 BATCH		
I SEM		
Applied Mathematics		CO1: Demonstrate knowledge and understanding of the underlying concepts of random variables and stochastic processes (PO3)
18ECELBSAM		CO2: Demonstrate knowledge of the mathematical concepts and computational aspects of linear algebra and graph theory (PO3)
		CO3: Analyse domain related engineering problems and develop analytical problem solving approach making use of the theoretical concepts (PO1)
Advanced Embedded Systems		CO1: Comprehend concepts in the field of Embedded Systems
18ECELGCES		CO2: Apply concepts to build and program Embedded Systems
		CO3: Develop C programs for execution on microcontroller/SOC development board based on ARM architecture. Develop Python programs to interface with Embedded Systems.
		CO4: Engage on market survey of various available Computer/Embedded architecture based on performance, power consumption and prizing criteria.
Advanced Computer Networks		CO1: To learn Network architectures and fundamental protocols.
18ECELPCCN		CO2: To understand the knowledge of internetworking concepts in various applications
		CO3: To Analyse and design using various network parameters

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Digital VLSI Design		CO1: Apply the concepts of MOS system in digital VLSI design
18ECELPEVD		CO2: Analyse the electrical and physical properties, Switching characteristics and interconnect effect of a MOS system in digital VLSI design
		CO3: Design dynamic logic circuits, Semiconductors Memory circuits, and different CMOS logic circuits.
		CO4: Use modern tools to simulate Schematic and Layout of Digital circuits individually/ in group (s) and Make an effective oral presentation and documentation on advanced topics related to the course by referring IEEE Journals.
Digital System Design		CO1: Apply the knowledge of constructs and conventions of Verilog / System Verilog for digital system design.
18ECELPCSD		CO2: Analyse different combinational and sequential digital systems and its design methodology
		CO3: Design combinational and sequential digital systems using Verilog / System Verilog
		CO4: Conduct experiments to demonstrate concepts related to HDL using Verilog/System Verilog
		CO5: Work in teams to design and demonstrate an application of digital system using Verilog and make an effective oral presentation and documentation.
Wireless Sensor Networks		CO1: Demonstrate understanding of the fundamental problems, tradeoffs, and design issues that arise in sensor network, as well as identify and critically evaluate sensor network technologies and solution approaches.
18ECELPESN		CO2: Understand the details of several particular protocols, as example implementations of fundamental principles, and digest descriptions of specific protocols, extracting the salient concepts
		CO3: Engage in original work and research in the area of sensor networks
2019 BATCH		
II SEM		
VLSI Desing and Verification		CO1: Ability to acquire knowledge on verification and apply for VLSI designs

18ECELPCVV		CO2: Analyse on verification methodologies and different types of simulators
		CO3: Design a solution to obtain 100% code coverage & functional coverage by determining the set of input constraints and assertions in test benches.
		CO4: Simulate the test bench architecture using system Verilog and analyse coverage reports
		CO5: Ability to work in team for verification of different digital system using EDA tool and make an effective oral presentation
synthesis and Optimization of Digital Circuits		CO1: Understand the process of synthesis and optimization in a top down approach for digital circuits models using HDLs.
18ECELPCSO		CO2: Apply different scheduling algorithms with resource binding and without resource binding for pipelined sequential circuits and extended sequencing models
		CO3: Apply different two level optimization algorithms for combinational circuits
		CO4: Ability to execute projects after getting familiar with VHDL and Cadence
Real Time Operating System		CO1: Design high performance software applications with real time deterministic response.
18ECELGCRT		CO2: Configure and Optimize Embedded RTOS to achieve desired High Performance Computing response.
		CO3: Make an effective oral presentation pertaining to RTOS and related high performance computing concepts.
		CO4: Engage on Literature survey about High Performance & Deterministic systems, both from hardware and software perspective and submit a report
Scripting Language		CO1: Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.
18ECELPESL		CO2: Demonstrate proficiency in handling Strings and File Systems

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		CO3: Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions
		CO4: Interpret the concepts of Object-Oriented Programming as used in Python.
		CO5: Implement exemplary applications related to Network Programming, Web Services and Databases in Python
Internet of Things		CO1: Interpret the impact and challenges posed by IoT networks leading to new architectural models for various case studies
18ECELOEIT		CO2: Compare and contrast the deployment of smart objects and the technologies to connect them to network.
		CO3: Elaborate the need for Data Analytics in IoT.

Name of the Programme	MTech – Digital Communication
PEOs	1. 2. 3.
Programme Outcomes (POs)	PO1: An ability to independently carry out research /investigation and development work to solve practical problems. PO2: An ability to write and present a substantial technical report/document. PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
Course Outcomes (COs)	**2019-20**
MTECHDIGITAL COMMUNICATION	
2019 BATCH	
I SEM	
Applied Mathematics	CO1: Demonstrate knowledge and understanding of the underlying concepts of random variables and stochastic processes

18ECDCBSAM	CO2: Demonstrate knowledge of the mathematical concepts and computational aspects of linear algebra and graph theory
	CO3: Analyse domain related engineering problems and develop analytical problem solving approach making use of the theoretical concepts
Wireless Networks	CO1: To develop the concept of wireless systems in the context of networks.
18ECDCPCWN	CO2: Ability to provide critical analysis of current research topics in the domain of Wireless Networks and prepare a technical document and present the same.
	CO3: To gain knowledge and analyze various algorithms of wireless networks and identify various research issues in wireless networks
Advanced Digital Communication	CO1: Acquire a scholarly knowledge of the different signalling and digital modulation techniques and to compare them in terms of their constellations, power spectra and bandwidth etc.
18ECDCPCDC	CO2: Perform characterization of AWGN channels, bandlimited channels and fading multipath channels, and a critical analysis of communication systems and receiver design techniques over different channels.
	CO3: Plan and execute basic and advanced simulations exercises related to digital communications in lab.
	CO4: Execute a group study of one advanced topic in digital communication (through IEEE journal papers).
	Prepare a technical documentation and presentation for the study performed by the team.
Optical Communication Networks	CO1: To gain knowledge on design of the latest generation of transmission systems and networks, and the factors limiting the system performance
18ECDCPEOC	CO2: Ability to execute a group study of one advanced topic in Optical communication (through IEEE journal papers) prepare a technical documentation and present the same
	CO3: To gain knowledge of the free space optics engineering

Radiating Systems	CO1: To provide comprehensive knowledge of different design and performance parameters of antenna and analyse their performance based on the radiation mechanisms and design different types of antenna arrays.
18ECDCPCRS	CO2: Apply analytical & numerical approach to understand different types of antennas arrays
	CO3: Understanding the concept of Computational Electromagnetics
	CO4: Usage of modern computational tools in electromagnetic scattering, propagation, and radiation.
	CO5: Ability to provide critical analysis of current research topics in the domain of antennas and prepare a technical document and present the same.
software Defined Ratio	CO1: Complete understanding of SDR Architecture
18ECDCPESD	CO2: Insight into system design from RF perspective
	CO3: Understand the concept of smart antenna systems.
	CO4: Ability to use modern tools for the design & implementation of an end to end communication System.
2019 BATCH	
II SEM	
Advanced Wireless Communication	CO1: Acquire knowledge about wireless II/O models for real time channels .
18ECDCPCAW	CO2: Ability to analyze the need of diversity and performance factors of fading multipath channels and MIMO systems.
	CO3: To implement the current research topics in Wireless communication, preparation of technical documentation and presentation of the work done
	CO4: Ability to independently formulate and analyze the design of wireless network models using simulator.
Advanced DSP	CO1: Ability to acquire the theoretical knowledge of advanced DSP, including FIR/IIR filter design, multirate DSP and adaptive filters
18ECDCGCAD	CO2: Ability to analyse and apply the theoretical concepts of DSP to real life problems of practical and numerical nature.

	CO3: Ability to select an IEEE journal paper covering a contemporary application of DSP, conduct appropriate literature survey pertaining to the topic, and solve and assimilate the selected paper..
	CO4: Ability to create a standard documentation and presentation of the study performed by their team
Communication System Security	CO1: Identify the factors driving the need for network security and the physical points of vulnerability in simple networks
18ECDCPESS	CO2: Study the various Mechanisms and Protocols that are available to Establish Protected Communications
	CO3: Be able to identify and present real world security attacks on networks and document the same
Communication Networking Systems	CO1: Apply the concepts of Computer Networks and Network Models for Data Communication.
18ECDCPECN	CO2: Analyze existing network protocols and networks.
	CO3: Analyze and exemplify current QoS architectures and mechanisms, the QoS support challenges in future networks
	CO4: Ability to identify the future opportunities and challenges associated with next generation networks and prepare a technical document.
Quality and Reliability of Engineering systems	CO1: Understand the concepts of quality control, improvement and management and design for quality.
18 ECDCOEQR	CO2: Understand the concepts of reliability and carry out reliability data analysis
	CO3: Learn fundamentals of reliability management and risk assessment and get acquainted with various reliability prediction and evolution methods.

Name of the Programme	MTech – VLSI & Embedded System
PEOs	PEO1: Graduates shall be capable of building their career in related industries, R&D establishments as well as in Teaching with their scholarly knowledge with respect to advanced topics in VLSI Design & Embedded system **PEO-2:** Graduates shall be capable of conceptualizing and analysing engineering problems of societal importance related to Design, implement, verification of Integrated circuit and embedded system, conduct independent research leading to technology solutions and communicate the outcomes through verbal and written mechanisms.

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<table>
<tr><td></td><td>PEO-3: Graduates shall be able to collaborate, manage and execute projects in teams using appropriate tools/technologies with utmost professionalism and acceptable good practices.</td></tr>
<tr><td>Programme Outcomes (POs)</td><td>PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: An ability to demonstrate a degree of mastery over the area of VLSI Design and Embedded systems. The mastery should be at a level higher than the requirements in the Electronics and communication engineering program (UG)</td></tr>
<tr><td>Course Outcomes (COs)</td><td>
<table>
<tr><th></th><th>2019-20</th></tr>
<tr><td colspan="2">MTECH VLSI DESIGN & EMBEDDED SYSTEM</td></tr>
<tr><td>2019 BATCH</td><td></td></tr>
<tr><td>I SEM</td><td></td></tr>
<tr><td>Applied Mathematics</td><td>CO1: Demonstrate knowledge and understanding of the underlying concepts of random variables and stochastic processes</td></tr>
<tr><td>18ECVEBSAM</td><td>CO2: Demonstrate knowledge of the mathematical concepts and computational aspects of linear algebra and graph theory</td></tr>
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<tr><td>18ECVEGCES</td><td>CO2: Apply concepts to build Embedded Systems</td></tr>
<tr><td></td><td>CO3: Develop C programs for execution on microcontroller/SOC development board based on ARM architecture. Develop Python programs to interface with Embedded Systems.</td></tr>
<tr><td></td><td>CO4: Engage on market survey of various available Computer/Embedded architecture based on performance, power consumption and pricing criteria.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Analog IC Design</td><td>CO1: Develop efficient analytical tools for quantifying the Analog circuits by inspection, aiming Analog design octagon.</td></tr>
<tr><td>18ECVEPCAI</td><td>CO2: Design stable Analog Integrated Circuits to meet given specification</td></tr>
<tr><td></td><td>CO3: Demonstrate Different Operational amplifier topologies through literature survey in groups.</td></tr>
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	Static Timing Analysis	CO1: Ability to apply the learnt basic concepts of STA to evaluate the delay of the circuits and analyse the generated report to identify critical issues and bottleneck for the violation and suggest the techniques to make the design to meet timing
	18ECVEPEST	CO2: Ability to write their own constraint file and create the environment required for the given design and its specification to undergo for analysis using the EDA tool.
		CO3: Ability to understand the journal research papers related to Timing analysis techniques and able to present suitable techniques for the given design.
	Digital IC Design	CO1: Design, write program and simulate Static and Dynamic circuits to meet the specification
	18ECVEPCDI	CO2: Analyse the given circuit to arrive at the specification
		CO3: Engage in literature survey in a group on the topic related to course and submit a detailed report
	Low Power VLSI Design	CO1: Ability to extend the knowledge on basics of MOSFETs and Power Dissipation in MOS circuits to obtain the concepts of different techniques for power optimization.
	18ECVEPELP	CO2: Ability to use the EDA tool to implement the designed circuit with techniques of power optimization in the design and justify obtained report by class room presentation.
		CO3: Ability to understand the journal research papers related to low power and updates their knowledge for new techniques to incorporate in projects of the specified stream.
	2019 BATCH	
	II SEM	
	Mixed Signal Circuit Design	CO1: Demonstrate Transceiver basic building blocks like PLL, Data converters, Sample and hold circuit.
	18ECVEPCMS	CO2: Design and simulation of identified blocks of Transceiver and submit a technical report
	Design for Testability	CO1: Apply the concept of faults and failure models to generate the number of fault models & Automatic Test Pattern Generator (ATPG) for the given design under test (DUT). Analyze and identify the given fault in given DUT(can be logic circuit or memory) and conclude the suitable available solution to test these faults.

	18ECVEPCDT	CO2: Ability to generate the Automatic Test Pattern Generation (ATPG) with different techniques using EDA tool
		CO3: Engage on Literature survey and make an effort to suggest new solution as a team
	Real Time Operating System	CO1: Design high performance software applications with real time deterministic response.
	18ECVEPCRT	CO2: Develop C programs and demonstrate the concepts of Embedded RTOS.
		CO3: Make an effective oral presentation pertaining to RTOS and related high performance computing concepts.
	System Verilog and Verification	CO1: Define, Understand and Explain OOPs concepts and system Verilog data types, Apply system Verilog constructs to create verification environment, Analyse coverage driven verification for given design under test(DUT)
	18ECVEPESV	CO2: Able to conceptualize and obtain 100% code coverage and functional coverage by determining the set of input constraints and assertions in test benches and able to document the effort to obtain coverage
	Physical Design	CO1: Demonstrate the basic design flow in VLSI physical design automation and the basic algorithms used for implementing the same
	18ECVEPEPD	CO2: Make an Effective Documentation of Physical Design Flow using industry level EDA tool.
	MEMS and Micro Systems	CO1: Understand the fundamentals of MEMS and its application, scaling, miniaturization, fabrication. Analyse the working of sensors, actuators and transducers. Design, modelling and packaging of micro systems
	18ECVEOEMM	CO2: Able to make Documentation of Innovations in MEMS and Micro Systems

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Academic Year 2019-20

Name of the Programme	**B.E. in Industrial Engineering and Management**
Programme Specific Outcomes (PSOs)	1. Analyze and solve complex industrial engineering problems using modern tools 2. Provide solutions to complex managerial problems using latest management techniques 3. Design and solve manufacturing and allied problems
Programme Outcomes (POs)	**PO1 Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. **PO2 Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **PO3 Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. **PO4 Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. **PO5 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. **PO6 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. **PO7 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.

	PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **PO9 Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. **PO10 Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. **PO11 Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. **PO12 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.
Course Outcomes (COs)	The COs for all the courses offered - Core and electives are given

3rd Semester

ENGINEERING MATHEMATICS-3 Course Code:19MA3BSEM3		
CO Number	**Course Outcomes**	**PO Number**
CO1	Compute solution of a system of algebraic equations.	PO2, 3
CO2	Determine whether a given system is stable or unstable.	PO2, 3
CO3	Express given functions to form Fourier series.	PO2, 3, 4
CO4	Demonstrate an understanding of Fourier transforms techniques	PO2, 3, 4
CO5	Employ analytical techniques to solve partial differential equations with appropriate boundary conditions	PO2, 3, 4
CO6	Apply Z- transforms techniques to solve difference equations.	PO2, 3
CO7	Use calculus of variations to find the external of a functional	PO2, 3

MANUFACTURING PROCESS Course Code:19IM3DCMAP		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the types of production of the products by conventional machining and comprehend the significance between conventional and non-conventional methods.	-
CO2	Ability to apply theoretical knowledge to know the mechanism, calculate machining time, tools required and various operations performed in Machine tools.	PO1
CO3	Ability to analyze skills and capabilities in the areas of advanced manufacturing methods like Rapid Prototyping based on energy sources and mechanisms employed.	PO2
CO4	Ability to Design castings while considering parameters such as strength, weight, and number of cores.	PO3

MECHANICS OF MATERIALS Course Code:19IM3DCMOM		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamentals of Strength of materials	-
CO2	Ability to apply the concepts to structural members to obtain the desired parameters	PO1
CO3	Ability to analyze complex engineering problems related to structural members based on a set of criteria.	PO2

CO4	Ability to design structural members considering appropriate materials based on mechanical properties to withstand the strength	PO3
CO5	Ability to analyze the micro structures and phase diagram & understand the basic terminologies associated with metallurgy to select metals and alloys for industrial applications	PO3

INDUSTRIAL METROLOGY Course Code:19IM3DCIME		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the principles and practices of metrology in manufacturing environment	-
CO2	Ability to apply the required formulae to calculate various parameters in the measurement systems.	PO1
CO3	Ability to analyze the measuring devices and instruments in varieties of applications	PO2
CO4	Ability to infer various physical quantities and surface measurement with the application of measuring instruments.	PO3

ELEMENTS OF ENERGY SYSTEMS Course Code:19IM3DCEES		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamental concepts of thermodynamics	- -
CO2	Ability to Apply the Principles of thermodynamics to solve problems	PO1
CO3	Ability to analyze the performance of an IC engine and fluid flow systems	PO2
CO4	Ability to solve the problems related to Fluid Mechanics	PO3

COMPUTER AIDED MACHINE DRAWING Course Code:19IM3DCCMD		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and visualize the concepts of detailed drawing of a given Machine Components.	-
CO2	Ability to apply the formulae to calculate the required dimensions to draw the views of machine component.	PO1
CO3	Ability to analyze the detailed component drawings to assemble the mechanical system.	PO2
CO4	Ability to create 2D and 3D models using modern software tool.	PO5,9,10

4th Semester

INDUSTRIAL ENGINEERING AND ERGONOMICS Course Code:19IM4DCIEE		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the Industrial Engineering concepts and to improve productivity of the resources.	-
CO2	Ability to apply the Industrial Engineering tools and techniques to eliminate the unproductive activities.	PO1
CO3	Ability to analyze and measure work to improve productivity.	PO2
CO4	Ability to apply various conventional and modern IE tools and techniques to measure work content and improve methodology	PO3,5,9,12
CO5	Ability to create better work eco system using various IE tools and techniques	PO1,5

FUNDAMENTALS OF PROGRAMMING TOOLS Course Code:19IM4DCFPT		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamental concepts of Programming for Industrial Engineering	- -
CO2	Ability to Analyze and Apply the Arduino Board for a given task	PO1
CO3	Ability to Analyze and Apply the Raspberry Pi Circuit for a given Application	PO1
CO4	Ability to create a MATLAB program to solve Numerical Methods problems	PO3

STATISTICS FOR ENGINEERS Course Code:19IM4DCSFE		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concepts of Statistics, probability theory, design of experiments and data analytics concepts.	-
CO2	Ability to apply the probability distribution for the given situation.	PO1
CO3	Ability to analyze and interpret the given statistical data	PO2
CO4	Ability to create Regression and correlation model for a given data.	PO3

COMPUTERS IN MANUFACTURING Course Code:19IM4DCCIM		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the basic concept of a CAD, NC and CNC system.	-
CO2	Ability to develop manual and APT part programs for 2D complex profiles and test the programs through simulation.	PO1
CO3	Ability to analyse the error in the program and choose right G and M codes to optimize the program and construct the final geometry by running the simulation using the software.	PO2
CO4	Ability to program for robot to perform typical tasks including Pick &Place, Stacking and to develop program for CNC to machine various profiles.	PO2,9
CO5	Ability to create complex geometries of machine components using CAD software. Develop G and M codes for turning and milling components. Produce the part using CNC machine.	PO5

ENGINEERING ECONOMY Course Code:19IM4DCENE		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain problem solving & decision making process in Engineering Economy	-
CO2	Ability to apply Engineering Economy tools to compare alternative proposals	PO1
CO3	Ability to analyze alternative proposals using Engineering Economy tools.	PO2
CO4	Ability to evaluate alternative proposals using Engineering Economy tools	PO3

MACHINE DESIGN Course Code:19IM4DCMCD		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of Static & fatigue strength in the design of mechanical components	-
CO2	Ability to apply and design procedural principles of machine elements to withstand loads and deformations.	PO1,4
CO3	Ability to analyze and evaluate designed components against the constraints set.	PO2

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5th Semester

COMPUTERS IN MANUFACTURING		**Course Code:16IM6DCCIM**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the basic concept of a CAD, NC and CNC system.	-
CO2	Ability to develop manual and APT part programs for 2D complex profiles and test the programs through simulation.	PO1
CO3	Ability to analyse the error in the program and choose right G and M codes to optimize the program and construct the final geometry by running the simulation using the software.	PO2
CO4	Ability to program for robot to perform typical tasks including Pick & Place, Stacking and to develop program for CNC to machine various profiles.	PO2, PO9
CO5	Ability to create complex geometries of machine components using CAD software. Develop G and M codes for turning and milling components. Produce the part using CNC machine.	PO5

OPERATIONS RESEARCH		**Course Code:16IM5DCOPR**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concepts, approaches and optimization in Operation Research Techniques.	-
CO2	Ability to apply and develop the mathematical skills related to Operation Research Techniques.	PO2
CO3	Ability to analyze and solve network models arising from a wide range of applications	PO3
CO4	Ability to evaluate real world problems using Operation Research Techniques.	PO4

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QUALITY ASSURANCE AND RELIABILITY		**Course Code:16IM5DCQAR**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the underlying reasons for modern quality methodologies, acceptance sampling plans and basic reliability concepts.	-
CO2	Ability to apply the knowledge of control charts, sampling plans and reliability to real world engineering problems	PO1, PO4
CO3	Ability to analyze and interpret the process data generated overtime for variable and attribute control charts.	PO2
CO4	Ability to conduct experiments using control charts, sampling plans and modern tool like Minitab to solve problems for given application.	PO5, PO9
CO5	Ability to engage in independent learning, submit a report and use ICT for effective presentation of the self- study on assigned topics related to Quality management.	PO10

ENGINEERING ECONOMY		**Course Code:16IM5DCENE**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain problem solving & decision making process in Engineering Economy	-
CO2	Ability to apply Engineering Economy tools to compare alternative proposals	PO1
CO3	Ability to analyze alternative proposals using Engineering Economy tools.	PO2
CO4	Ability to evaluate alternative proposals using Engineering Economy tools	PO3

FACILITIES PLANNING AND DESIGN		**Course Code:16IM5DCFPD**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain various factors influencing the decision regarding Facilities Planning using traditional and computerized techniques.	-
CO2	Ability to apply Facilities Planning and design tools to solve numerical problems to plan and design facilities layout.	PO1
CO3	Ability to analyze Facilities Planning problems and improve existing layouts for different product lines using modern tools.	PO2, PO5
CO4	Ability to create and evaluate single facility and multiple facility location situations using MCDM techniques and enabling creative application of AHP methods.	PO3, PO5

Electives:

APPLIED THERMODYNAMICS		**Course Code: 16IM5DEAPT**
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the Laws of thermodynamics	-
CO2	Ability to apply the concepts and principles of thermodynamics to solve simple and complex engineering problems.	PO1
CO3	Ability to analyze the complex Engineering problems using principles and concepts of thermodynamics.	PO2
CO4	Ability to evaluate thermodynamic systems to assess the performance of various systems	PO4

PRODUCT DESIGN & DEVELOPMENT	**Course Code:16IM5DEPDD**	
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the Product design and development process.	-
CO2	Ability to apply the concepts of Product design and development process to develop the Engineering products.	PO1
CO3	Ability to analyze and develop new products using Product design and development concepts.	PO2
CO4	Ability to listen and comprehend audio/video lectures related to product design and development.	PO10 PO12

ORGANIZATIONAL BEHAVIOR **Course Code:16IM5DEOBE**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concept of organizational behavioural theories	-
CO2	Ability to apply organizational behaviour concepts, models and theories to real life management situations through case analysis	PO1

CO3	Ability to analyze the behaviour of individuals and groups in organizations in terms of organizational behaviour theories, models and concepts	PO2
CO4	Ability to demonstrate and communicate effectively in oral and written forms about organizational behaviour theories and their application using appropriate concepts, logic and rhetorical conventions.	PO9

THEORY OF MACHINES **Course Code: 16IM5DETOM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of machines, mechanisms and related terminologies.	-
CO2	Ability to apply various motion transmissions of mechanical elements.	PO1
CO3	Ability to analyze graphical design aspects of mechanisms and their uses.	PO2
CO4	Ability to create mechanisms for carrying out mechanical work.	PO3

TOOL ENGINEERING **Course Code: 16IM5DETEG**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the requirements of cutting tools	-
CO2	Ability to apply combination of cutting tool materials to improve the tool life.	PO1
CO3	Ability to analyze different cutting tools for different machining processes.	PO2
CO4	Ability to create cutting tools with advanced materials for different machining processes.	PO3

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6th Semester

SIMULATION MODELING AND ANALYSIS **Course Code: 16IM6DCSMA**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamental concepts of Simulation and Modeling for Industrial Engineering stream.	-
CO2	Ability to apply the concepts and techniques of Simulation to formulate and solve Industrial Engineering problems	PO1
CO3	Ability to analyze Industrial Engineering Problems and interpret and validate	PO2
CO4	Ability to model and Simulate using software packages to find the solution to complex Engineering problems	PO3
CO5	Ability to create Statistical model using simulation package like Arena / Witness and to perform Sensitivity analysis / Post optimal analysis for the generated model	PO5, PO9, PO10

FINANCIAL ACCOUNTS AND COSTING **Course Code: 16IM6DCFAC**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of Financial accounting and Costing	-
CO2	Ability to apply the financial concepts and techniques to solve Financial accounting and costing problems in an industry.	PO1
CO3	Ability to analyze and evaluate the financial aspects of accounting, costing and budgeting.	PO2
CO4	Ability to create the Journal transactions, trial balance, trading account, profit and loss account and balance sheet.	PO4, PO11

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PRODUCTION AND OPERATIONS MANAGEMENT **Course Code: 16IM6DCPOM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts and principles of Production and Operations Management	-
CO2	Ability to apply concepts and principles of Production and Operations Management to solve Engineering and management Problems	PO1
CO3	Ability to analyze Engineering and management Problems and to propose optimal solutions	PO2
CO4	Ability to design aggregate plans and master schedules, MRP & CRP solutions to Industrial Engineering problems	PO3

SUPPLY CHAIN AND LOGISTIC MANAGEMENT **Course Code: 16IM6DCSCL**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the importance and significance of inventory in industry.	-
CO2	Ability to apply the supply chain strategies to address societal issues.	PO1, PO6
CO3	Ability to analyze the supply chain drivers and modes of transportation to benefit industry and society.	PO2
CO4	Ability to evaluate the supply chain performance and infer on effectiveness.	PO4
CO5	Ability to demonstrate and communicate effectively in oral and written forms about supply chain strategies ,reverse logistics, Six Sigma and Lean manufacturing with respect to implementation in the Industrial Scenario	PO5, PO9, PO10

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Electives

FLUID MECHANICS **Course Code: 16IM6DEFM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts and principles of Fluid Mechanics	-
CO2	Ability to apply the concepts and principles of Fluid Mechanics to solve engineering problems	PO1
CO3	Ability to analyze energy transfer in fluid Mechanics to interpret the results.	PO2
CO4	Ability to evaluate the problems related to Fluid Mechanics.	PO3

SOFTWARE ENGINEERING AND MANAGEMENT **Course Code:16IM6DESEM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts and principles of software project management	-
CO2	Ability to apply the principles and concepts of software project management to solve Engineering and management problems.	PO1
CO3	Ability to test the software system to validate the processes.	PO2
CO4	Ability to design the software to develop the quality assurance concepts	PO3

DATA BASE MANAGEMENT SYSTEM **Course Code: 16IM6DEDBM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand DBMS architecture, languages, interfaces, data modeling	-
CO2	Ability to apply relational model concepts, schemas to business functions, Hashing	PO1
CO3	Ability to evaluate models, ER Diagrams, system implementation, SQL queries and DBMs systems	PO4, PO5
CO4	Ability to create complex SQL queries, stored procedures.	PO3, PO4

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WORLD CLASS MANUFACTURING **Course Code: 16IM6DEWCM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of World Class Manufacturing Practices, re-engineering, benchmarking etc.	-
CO2	Ability to analyze effective implementation of World-Class manufacturing practices, re-engineering, benchmarking etc .	PO2
CO3	Ability to listen, comprehend and communicate audio/video lectures related to WCM	PO9, PO10, PO12

INDUSTRIAL POLLUTION CONTROL **Course Code: 16IM6DEIPC**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain various concepts of Pollution Control methods and various control measures and acts adopted all over the globe.	-
CO2	Ability to apply general consideration of pollution control and treatment of E- wastes and radioactive wastes.	PO1
CO3	Ability to analyze various practical cases and infer the extent of environmental, social and economic damage due grave industrial disasters all over the globe.	PO2
CO4	Ability to implement various pollution prevention methods adopted across industries all over the world	PO5

ADVANCED OPERATIONS RESEARCH **Course Code:16IM6DEAOR**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concepts, approaches and optimization in Operation Research Techniques.	-
CO2	Ability to apply and develop the mathematical skills related to Operation Research Techniques.	PO2
CO3	Ability to analyze and solve network models arising from a wide range of applications	PO3
CO4	Ability to evaluate real world problems using Operation Research Techniques.	PO4

AUTOMATION IN MANUFACTURING **Course Code: 16IM6DEAIM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of automation and its different types and to find solutions to the implications of the global factors on the society.	-
CO2	Ability to apply the knowledge of automated flow line, storage buffer line (with and without) to solve line balancing problems	PO1
CO3	Ability to analyze different types of automated guided vehicles, Vehicle guidance and routing, and system management.	PO2
CO4	Ability to develop part families by the of Group technology concepts, and apply knowledge on CAPP and manage product data.	PO3

MARKETING MANAGEMENT **Course Code: 16IM6DEMKM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts, principles and functions of Marketing.	-
CO2	Ability to apply marketing concepts and principles to solve business/corporate marketing problems.	PO1, PO2
CO3	Ability to analyze strategies which enable decision making process.	PO2
CO4	Ability to use appropriate models and techniques to the study ever-changing environment.	PO5
CO5	Ability to create the idea into a viable marketing plan.	PO5

HYDRAULICS AND PNEUMATICS **Course Code: 16IM6DEHYP**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts, principles and working of hydraulics and Pneumatics systems.	-
CO2	Ability to apply concepts and formulae to calculate the performance characteristics of hydraulics	PO1

	systems.	
CO3	Ability to design and analyze hydraulic circuits to perform various tasks using fluid power	PO2, PO3
CO4	Ability to construct and maintain hydraulic and pneumatic systems for various application areas	PO3

7th Semester

ENTERPRISE RESOURCE PLANNING Course Code: 17IM7DCERP		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain business functions and business processes, concepts , importance of ERP	-
CO2	Ability to Apply concepts to the functional modules of ERP software	PO1
CO3	Ability to evaluate basics of ERP implementation, Package selection, transition strategies, implementation process	PO5
CO4	Ability to implement ERP solutions to various business functions, through self-study and laboratory exercises.	PO3, PO4, PO9, PO10

TOTAL QUALITY MANAGEMENT Course Code: 17IM7DCTQM		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the quality concepts and the practical evolution in management, revolution in total quality management	-
CO2	Ability to apply the quality tools and methods in the manufacturing and service processes	PO1
CO3	Ability to analyze the TQM related cases and quality improvement process	PO2

Electives

DESIGN FOR MANUFACTURABILITY **Course Code: 17IM7DEDFM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the various principles of Design For Manufacturability	-
CO2	Ability to apply different Manufacturability techniques for different applications.	PO1
CO3	Ability to analyze various products for their underlying manufacturing techniques, and suggest improvements if required.	PO2
CO4	Ability to design casting specimens considering manufacturing cost, minimize the number of cores and retain casting strength.	PO3

INDUSTRIAL DESIGN AND ERGONOMICS **Course Code: 17IM7DEIDE**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the importance of ergonomics and aesthetics in industrial design.	-
CO2	Ability to apply industrial design methodology like effect of display, size, shape, colour and function while designing new products.	PO1
CO3	Ability to analyze the concepts of interfacing man to machine in product design and the effect of environment on working efficiency of human beings.	PO2, PO6
CO4	Ability to design and evaluate products for its function, ergonomics and aesthetics.	PO3

SYSTEM DYNAMICS **Course Code: 17IM7DESMD**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concept of system thinking, modeling, transfer function, Frequency-domain techniques	-
CO2	Ability to apply Characteristics roots and equations for space formulation and mathematical modeling of Dynamic Systems	PO1
CO3	Ability to develop skills in analyzing Simulating and identifying systems based upon their I/P and O/P responses	PO2
CO4	Ability to design and analyze the basic feedback systems	PO3

NON-CONVENTIONAL MACHINING **Course Code: 17IM7DENCM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the various working principles of Non- conventional processes	-
CO2	Ability to apply various process parameters to achieve the optimum machining conditions of various non-conventional machines.	PO1
CO3	Ability to analyze the outcomes of various non-conventional machining processes.	PO2
CO4	Ability to demonstrate WJM and EDM	PO3
CO5	Ability to listen and comprehend audio/video lectures related to non-conventional machining	PO10

COMBINATORIAL OPTIMIZATION **Course Code : 17IM7DECOO**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to Understand and explain the concepts of combinatorial optimization	-
CO2	Ability to apply evolutionary Computation Methods to find solutions to complex problems by genetic Algorithm and the Combinatorial Optimization methods	PO1
CO3	Ability to analyze Combinatorial Optimization problems	PO2

ARTIFICIAL INTELLEGENCE AND EXPERT SYSTEMS **Course Code: 17IM7DEAIE**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain thoughts on AI, its applications, KR, WFFs Reasoning mechanisms including Uncertainty and the idea of Expert Systems.	-
CO2	Ability to apply AI ideas in various applications, manipulation and conversion of WFFs and adopting Uncertainty Reasoning mechanisms.	PO1
CO3	Ability to analyze WFFs and manipulating them to handle common sense Reasoning mechanisms, Expert Systems, GA and also machine learning system.	PO2

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THEORY OF CONSTRAINTS	**Course Code: 17IM7DETOC**	
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain concepts of theories of Constraints	-
CO2	Ability to apply various applications of theory of constraints on various sectors	PO1
CO3	Ability to analyze different cases of Theory of constraints	PO2
CO4	Ability to use of modern tools to resolve the issues of theory of constraints	PO5

INDUSTRIAL EXPERIMENTATION	**Course Code: 17IM7DEIEX**	
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the principles of analysis of variance and experimental designs	-
CO2	Ability to apply & construct the appropriate experimental design for a particular problem.	PO1, PO3
CO3	Ability to analyze the data & interpret the experimental results	PO2

LEAN MANUFACTURING	**Course Code: 17IM7DELNM**	
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of Lean manufacturing	-
CO2	Ability to apply the Lean manufacturing systems strategies to address its impact	PO1
CO3	Ability to analyze the tools and techniques of Lean and apply in various manufacturing sector.	PO2
CO4	Ability to evaluate the contribution achieved by implementing lean in various sectors.	PO3
CO5	Ability to design the 5S model for various sectors and analyze its effectiveness	PO3

MANAGEMENT INFORMATION SYSTEM		
Course Code	**17IM7DEMIS**	
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand information systems, business	-

	operations, E-business models & EDI	
CO2	Ability to apply appropriate system analysis and design methodologies to enhance existing information systems and business processes.	PO1
CO3	Ability to analyze complex information technologies.	PO2
CO4	Ability to evaluate technical and managerial skills in information technology.	PO3

HUMAN RESOURCE MANAGEMENT Course Code:17IM7DEHRM		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concept of Human Resource Management	-
CO2	Ability to apply the processes related to Human Resource Management.	PO1
CO3	Ability to analyze the behaviour of individuals with respect to legal implication with respect to Industrial Relations	PO2
CO4	Ability to demonstrate and communicate effectively in oral and written forms about personnel interviews, selection placement induction, orientation, training and development.	PO9, PO10
CO5	Ability to evaluate- audit, account, record keeping and monitoring behaviours in organizations	PO5
RELIABILITY ENGINEERING Course Code:17IM7DERLE		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamentals of reliability	-
CO2	Ability to apply concepts of reliability, availability, maintainability component failure data	PO1
CO3	Ability to analyze the interference between strength and stress, or life data for estimating reliability and also strategies for enhancing reliability of components and systems	PO2
CO4	Ability to design for maintainability and Availability analysis	PO3

Institutional Elective-I

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DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT

DATA BASE MANAGEMENT SYSTEM **Course Code :17IM7IEDBMS**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand DBMS architecture, languages, interfaces, data modeling	-
CO2	Ability to apply relational model concepts, schemas to business functions, Hashing	PO1
CO3	Ability to evaluate models, ER Diagrams, system implementation, SQL queries and DBMs systems	PO3, PO4
CO4	Ability to create complex SQL queries, stored procedures	PO3,PO4

HUMAN RESOURCE MANAGEMENT **Course Code :17IM7IEHRM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concept of Human Resource Management	-
CO2	Ability to apply the processes related to Human Resource Management.	PO1
CO3	Ability to analyze the behaviour of individuals with respect to legal implication with respect to Industrial Relations	PO2
CO4	Ability to demonstrate and communicate effectively in oral and written forms about personnel interviews, selection placement induction, orientation, training and development.	PO9, PO10
CO5	Ability to evaluate- audit, account, record keeping and monitoring behaviours in organizations	PO5

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OPERATIONS RESEARCH **Course Code: 16MD7IEOPR**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concepts, approaches and optimization in Operation Research Techniques.	-
CO2	Ability to apply and develop the mathematical skills related to Operation Research Techniques.	PO2
CO3	Ability to analyze and solve network models arising from a wide range of applications	PO3
CO4	Ability to evaluate real world problems using Operation Research Techniques.	PO4

PRODUCT DESIGN AND DEVELOPMENT **Course Code:17IM7IEPDD**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the Product design and development process.	**-**
CO2	Ability to apply the concepts of Product design and development process to develop the Engineering products.	PO1
CO3	Ability to analyze and develop new products using Product design and development concepts.	PO2
CO4	Ability to listen and comprehend audio/video lectures related to product design and development.	PO10 PO12

AUTOMATION IN MANUFACTURING **Course Code: 17IM7IEAIM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of automation and its different types and to find solutions to the implications of the global factors on the society.	-
CO2	Ability to apply the knowledge of automated flow line, storage buffer line (with and without) to solve line balancing problems	PO1
CO3	Ability to analyze different types of automated guided vehicles, Vehicle guidance and routing, and system management.	PO2
CO4	Ability to develop part families by the of Group technology concepts, and apply knowledge on CAPP and manage product data.	PO3

SIX SIGMA **Course Code: 17IM7IESS**

CO Number	Course Outcomes	PO Number
CO1	Ability to understand and explain the concepts of Six Sigma	-
CO2	Ability to apply the knowledge of Six Sigma methods and tools	PO1
CO3	Ability to analyze different types Six sigma methods	PO2
CO4	Ability to demonstrate the design of Experiments through Catapult Experiment	PO3

SIMULATION MODELING AND ANALYSIS **Course Code:17IM7IESMA**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the fundamental concepts of Simulation and Modeling for Industrial Engineering stream.	-
CO2	Ability to apply the concepts and techniques of Simulation to formulate and solve Industrial Engineering problems	PO1
CO3	Ability to analyze Industrial Engineering Problems and interpret and validate	PO2
CO4	Ability to model and Simulate using software packages to find the solution to complex Engineering problems	PO3
CO5	Ability to create Statistical model using simulation package like Arena / Witness and to perform Sensitivity analysis / Post optimal analysis for the generated model	PO5, PO9, PO10

8th Semester

ELECTIVE

TECHNOLOGY MANAGEMENT **Course Code 17IM8DETM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of Technology Management	-
CO2	Ability to apply various drivers of Technological Invention and Innovation	PO1

CO3	Ability to analyze product / process for industrial applications , and is patentability	PO2

RETAIL AND SERVICE MANAGEMENT **Course Code:17IM8DERSM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain marketing strategies in business organizations and academics.	-
CO2	Ability to apply the knowledge of marketing in Retail scenario	PO1
CO4	Ability to evaluate the cases of the Industry with respect to competitive ability (TCA)	PO3

VALUE ENGINEERING **Course Code: 17IM8DEVAE**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain concept of Value, value analysis, value engineering, function.	-
CO2	Ability apply VE techniques to product, processes, systems, components, parts etc.	PO1
CO3	Ability to analyze value engineering techniques to the real world problems	PO2
CO4	Ability to design the value added products by value engineering	PO3

CO3	Ability to analyze different ways that retailers use marketing tools and techniques to interact with their customers	PO2
CO4	Ability to design and developing the flow of routes and services in the retail environment	PO3

SIX SIGMA
Course Code:17IM8DESS

CO Number	Course Outcomes	PO Number
CO1	Ability to understand and explain the concepts of Six Sigma	-
CO2	Ability to apply the knowledge of Six Sigma methods and tools	PO1
CO3	Ability to analyze different types Six sigma methods	PO2
CO4	Ability to demonstrate the design of Experiments through Catapult Experiment	PO3

Institutional Elective-II

ENTERPRISE RESOURCE PLANNING

Course Code: 17IM8IEERP

CO Number	Course Outcomes	PO Number
CO1	Ability to understand and explain business functions and business processes, concepts , importance of ERP	-
CO2	Ability to Apply concepts to the functional modules of ERP software	PO1
CO3	Ability to evaluate basics of ERP implementation, Package selection, transition strategies, implementation process	PO5
CO4	Ability to implement ERP solutions to various business functions, through self-study and laboratory exercises.	PO3, PO4 PO9,PO10

OPERATIONS RESEARCH

Course Code:16MD8IEOPR

CO Number	Course Outcomes	PO Number
CO1	Ability to understand the concepts, approaches and optimization in Operation Research Techniques.	-
CO2	Ability to apply and develop the mathematical skills related to Operation Research Techniques.	PO2
CO3	Ability to analyze and solve network models arising from a wide range of applications	PO3
CO4	Ability to evaluate real world problems using Operation Research Techniques.	PO4

ADVANCED OPERATIONS RESEARCH **Course Code:17IM8IEAOR**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the concepts, approaches and optimization in Operation Research Techniques.	-
CO2	Ability to apply and develop the mathematical skills related to Operation Research Techniques.	PO2
CO3	Ability to analyze and solve network models arising from a wide range of applications	PO3
CO4	Ability to evaluate real world problems using Operation Research Techniques.	PO4

MARKETING MANAGEMENT **Course Code:17IM8IEMKM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts, principles and functions of Marketing.	-
CO2	Ability to apply marketing concepts and principles to solve business/corporate marketing problems.	PO1, PO2
CO3	Ability to analyze strategies which enable decision making process.	PO2
CO4	Ability to use appropriate models and techniques to the study ever-changing environment.	PO5

CO5	Ability to create the idea into a viable marketing plan.	PO5

MANAGEMENT AND ENTREPRENEURSHIP **Course Code:17IM8IEMAE**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand the basic principles and concepts of management and Entrepreneurship	-
CO2	Ability to apply the principles of management and entrepreneurship.	PO1
CO3	Ability to analyze Management issues to solve the problem to facilitate decision making.	PO2
CO4	Ability to formulate and evaluate the feasibility of the project report	PO3

PROJECT MANAGEMENT **Course Code:17IM8DCPM**		
CO Number	**Course Outcomes**	**PO Number**
CO1	Ability to understand and explain the concepts of Project Management	-
CO2	Ability to apply the knowledge to identify the resources needed for each stage, including stakeholders, tools and supplementary materials.	PO1
CO3	Ability to analyze and optimize project network considering factors such as task dependencies, task lengths, leadership styles and organizations structures to successfully complete a project.	PO2
CO4	Ability to evaluate the project network to reduce time and cost by considering factors such as estimated cost, variances and profits and performance evaluation of project and team members.	PO3

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Academic Year 2019-20

Name of the Programme	B.E. in Computer Science and Engineering
Programme Specific Outcomes (PSOs)	PSO1. Apply Software Engineering Principles and Practices to provide software solutions. PSO2. Design and Develop Network, Mobile and Web based Computational systems under realistic constraints PSO3. Design efficient algorithms and develop effective code.
Programme Outcomes (POs)	**PO1 to PO12** PO1- Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2- Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3- Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4- Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. PO5- 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. PO6- 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. PO7- 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.

	PO8- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9- Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10- Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11- Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12- 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.

Course Title and Course Code	**Course Outcomes**
	3rd semester
Statistics and Discrete Mathematics 19MA3BSSDM	CO1-Use graphs as representation tool in network analysis
	CO2-Demonstrate an understanding of the basic concepts of Combinatorics.
	CO3-Apply the concepts for probability, Statistics and Queuing theory.
Microprocessors and Microcontrollers 19CS3ESMMC	CO1-Ability to apply the knowledge of architecture, instruction set and assembly language programming of microprocessor and microcontroller.
	CO2-Ability to analyze the attributes of Microprocessors & Microcontrollers to address the given problem
	CO3-Ability to design microprocessor and microcontroller based systems
	CO4-Ability to conduct experiments using assembly language programming to demonstrate the features of microprocessor and microcontroller.
Data Structures	CO1-Apply the concept of linear and nonlinear data structures to

19CS3PCDST	various applications
	CO2-Analyse the usage of appropriate data structure for a given application
	CO3-Design and implement operations of linear and nonlinear data structure
	CO4-Ability to conduct practical experiments for demonstrating the operations of different data structures.
Object Oriented Java Programming 19CS3PCOOJ	CO1-Apply knowledge of Java constructs for developing programs/applications.
	CO2-Analyse the given Java program to identify bugs and to write correct code.
	CO3-Design Java programs/ applications for a given requirement.
	CO4-Conduct practical experiments for demonstrating features of Java using eclipse.
Computer Organization and Architecture 19CS3PCCOA	CO1-Ability to apply the concepts of basic functional units to demonstrate the working of computational system
	CO2-Ability to analyse the design issues in the development of processor and other components to articulate improvement in computer design
	CO3-Ability to design memory modules and Arithmetic Logic unit by analysing performance issues
	.
Logic Design 19CS3PCLOD	CO1-Ability to apply the minimization techniques to digital circuits.
	CO2-Ability to analyse functionality of the digital circuits.
	CO3-Ability to design efficient combinational and sequential logic circuit implementations from functional description of digital systems.
	CO4-Ability to use CAD tools to simulate and verify logic circuits.
Environmental studies 19HS3PCEVS / 19HS4PCEVS	CO1-Understand the components and impacts of human activities on environment.
	CO2-Apply the environmental concepts for conservation and protection of natural resources.
	CO3-Identify and establish relationship between social, economical and ethical values from environmental perspectives.
Project Work-119CS3PWPW1	CO1-Ability to apply practical knowledge and latest tools usage along with project development.
	CO2-Ability to design and develop a project using web technologies to solve societal problems.
	CO3-Ability to report and present the implemented solutions in a team
Physical Activity (Sports/ Yoga Etc.) 19CS3NCNC3	CO1-Promoting comprehensive health, safety, and physical fitness by engaging in competitive activities

	CO2-Demonstrates personalities of virtuous sportsmanship and teamwork in both competition and practice.
Additional Mathematics-I 19MA3IMMAT	CO1-Understand the basic concepts of differentiation and integration.
	CO2-Apply the concepts of polar curves and multivariate calculus.
	CO3-Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.
	CO4-Apply techniques of vector calculus to engineering problems.
	CO5-Comprehend the generalization of vector calculus in curvilinear coordinate system.

	4th semester
Linear Algebra 19MA4BSLIA	CO1-Apply the concepts of Matrices to linear systems and Vectors spaces.
	CO2-Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra.
	CO3-Apply the concepts of inner products to matrix decomposition.
Theoretical Foundations of Computations 19CS4PCTFC	CO1-Able to Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving the Problem.
	CO2-Ability to analyse the given Automata, Regular Expression & Grammar to know the Language it represents.
	CO3-Design Automata & Grammar for pattern recognition and syntax checking.
Database Management Systems 19CS4PCDBM	Ability to apply the concepts of database management system for various applications.
	Ability to analyse the given database concepts to its correctness.
	Ability to design and demonstrate conceptual models, query and optimization.
	Ability to conduct experiments to demonstrate the various SQL query processing.
Analysis and Design of Algorithms 19CS4PCADA	Ability to analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.
	Ability to design efficient algorithms using various design techniques.
	Ability to apply the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete
	Ability to conduct practical experiments to solve problems using an appropriate designing method and find time efficiency.
Operating Systems 19CS4PCOPS	CO1-Ability to Apply Various Process Scheduling Algorithms, Disk Scheduling algorithms, Page replacement algorithms and

	Deadlock detection and avoidance techniques for providing Operating System functionalities
	CO2-Ability to Analyse various process management concepts (including scheduling, synchronization and deadlocks), Memory Management strategies and Design considerations of file system.
	CO3-Ability to Demonstrate the Basic Concepts of Operating System.
Constitution of India, Professional Ethics and Human Rights 19IC3HSCPH / 19IC4HSCPH	CO1-Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land.
	CO2-Analyse the concepts and ideas of Human Rights.
	CO3-Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
Seminar Technical / Internship 19CS4SRSTI	CO1-Ability to apply domain knowledge during the course of internship or research paper presentation
	CO2-Ability to work independently and in a collaboration/multidisciplinary environment.
	CO3-Ability to demonstrate effective verbal and written communication skills
	CO4-Ability to exhibit integrity and ethical behavior while research paper presentation or carrying out the internship on site.
	CO4-Ability to allocate time effectively and manage to complete the work allotted within appropriate time
Project Work-2 19CS4PWPW2	CO1-Ability to apply practical knowledge and latest tools usage along with project development.
	CO2-Ability to design and develop a project using Database technologies to solve societal problems.
	CO3-Ability to report and present the implemented solutions in a team
Cultural Activity (Music/Dance etc.) 19CS4NCNC4	CO1-Able to reflect creatively on artistic and cultural processes of the society.
	CO2-Demonstrate characters of individuality and teamwork in both competition and practice.
Additional Mathematics-II 19MA4IMMAT	Use Laplace transforms to solve differential equations.
	Apply multiple integrals of plane figures to compute areas and volume.
	Use Gamma and Beta functions to evaluate integrals.
	Ability to understand the use of integral calculus in scalar and vector fields.

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Course Outcomes (COs)	5th SEMESTER **ANALYSIS AND DESIGN OF ALGORITHMS-16CS5DCADA** • CO1- Ability to analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations. • CO2- Ability to **design** efficient algorithms using various design techniques. • CO3- Ability to **apply** the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete • CO4- Ability to **conduct** practical experiments to solve problems using an appropriate designing method and find time efficiency. **Software Engineering-16CS5DCSWE** • CO1- Ability to **apply** Software Engineering Design Techniques and practices for developing Software. • CO2- Ability to **analyze** the various requirements, design and Testing Techniques to select the appropriate techniques for the software system. • CO3- Ability to **Design** Models for different phases of software development to solve real world problems. • CO4- Ability to Manage **Projects** by Estimating cost and time required for developing the Software Product. **Computer Networks-16CS5DCCON** • CO1- Ability to apply conceptual and implementation aspects for network applications. • CO2- Ability to analyse the various protocols in network, transport and application layers and their mechanisms. • CO3- Ability to design functional aspects for network applications. • CO4- Ability to develop programs that demonstrate the operations of network, transport and application layers

	Internet of Things-15CS5DCIOT • CO1- Ability to **apply** various protocols, device discovery and cloud services in resource constraint network for IoT applications • CO2- Ability to **analyse** the various IoT architectural components. • CO3- Ability to **develop** IOT systems using with Arduino development board by interfacing sensors, communication modules and actuators • CO4- Ability to **conduct** experiments to **demonstrate** the working of sensors, actuators, communication modules using Arduino IDE. • CO5- Ability to perform in a team to design and develop IoT applications that address various real time problems. **Programming in Python-15CS5DEPIP** • CO1- Ability to apply the knowledge of Python programming to develop different applications. • CO2- Ability to analyze the given python program to identify bugs and to rectify it. • CO3- Ability to design GUI and Graphics applications for a given requirement using python programming. • CO4- Ability to conduct practical experiments for given requirements using python. • CO5- Ability to develop a project using python for a given requirement and make effective Oral Presentation and documentation. 6th SEMESTER **Theoretical Foundations of Computation-16CS6DCTFC** • CO1- Able to Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving the Problem. • CO2-Ability to analyze the given Automata, Regular Expression & Grammar to know the Language it represents.

	• CO3- Design Automata & Grammar for pattern recognition and syntax checking. **Object Oriented Modeling and Design-16CS6DCOOM** • CO1- Ability to apply the knowledge of class, State & Interaction Modeling using Unified Modeling Language to solve a given problem. • CO2- Ability to analyze a System for a given requirement using Unified Modeling language. • CO3- Ability to design a given system using high level strategy. • CO4- Ability to conduct practical experiment to solve a given problem using Unified Modeling language. **Mobile Application Development-15CS6DCMAD** • CO1- Ability to **apply** knowledge of mobile app development using android packages and resources for different applications. • CO2- Ability to **analyze** the given android program to identify bugs and to write correct code. • CO3- Ability to **design** android mobile applications for a given requirement. • CO4- Ability to conduct practical experiments for demonstrating features of mobile applications using android studio platform • CO5- Ability to **develop** a **project** using android studio platform to solve societal problems. **Cryptography and Network Security-15CS6DECNS** • CO1- Ability to apply knowledge of number theory and cryptography to demonstrate the techniques for data security • CO2- Ability to analyze the encryption algorithms for their strengths and weaknesses • CO3- Ability to design and implement basic algorithms in cryptography **Software Project Management and Finance-16CS6HSHS1**

	• CO1- Ability to identify and apply Software Project management concepts for software development. • CO2- Ability to analyze and estimate the Scope, cost and outline the project plan. • CO3- Ability to develop project planning using Gantt chart and identify issues with project life cycle. **Cloud Computing-16CS6DECCT** • **CO1-** Ability to apply the knowledge of cloud technology to demonstrate the working principles of cloud • CO2- Ability to analyse cloud services extended by various cloud providers to build a cloud • CO3- Ability to conduct practical experiments for demonstrating the features of cloud computing services • CO4- Ability to explore cloud simulator and come up with a new resource sharing module for various requirements **Fuzzy Logic and Neural Networks-16CS6DEFLN** • CO1- Ability to **apply** concepts of Neural Networks and Fuzzy logic for learning and knowledge representation. • CO2- Ability to **analyze**neural networks and fuzzy systems • CO3- Ability to make effective **Oral presentation** on current trends in Neural Networks and Fuzzy logic. **Artificial Intelligence Course Code: 16CS6DCAIN** • CO1- Ability to **apply** knowledge of agent architecture, searching and learning techniques for different applications. • CO2- Ability to **analyze** Inference and Learning Techniques. • CO3- Ability to **design** a reasoning system for a given requirement. • CO4- Ability to **conduct** practical experiments for demonstrating agents, searching and inferencing.

	• CO5- Ability to **develop** a project using Artificial Intelligence techniques to solve real world problems. 7th SEMESTER **Data Science Using R-16CS7DEDSC** • CO1- Ability to apply the Concepts of R programming for a given Requirement • CO2- Ability to analyse the given data using data analytic Technique. • CO3- Ability to Conduct Practical experiments for the demonstration of data analytic techniques Using R • CO4- Ability to design and develop data science project using R for real world applications. **Distributed Operating System -16CS7CEDOS** • CO1-Ability to Apply the knowledge of memory management, Communication, process and file management of Distributed operating system Functionalities. • CO2-Ability **to** Analyze memory management, communication, process and file management of Distributed Operating System Functionalities. • CO3-Ability to **present** case study on current Distributed operating system Functionalities. **Probability, Statistics and Queuing-16CS7DCPSQ** • **CO1-** Ability to **apply** knowledge of probability, random variables and queuing theory to find probabilities of events. • CO2- Ability to **analyze** data distributions through statistical inference and performance of queuing systems. • CO3- Ability to **design** solutions to problems with the knowledge of probability, random variables and queuing theory. **Big Data Analytics-15CS7DEBDA** • **CO1-** Ability to apply the concepts of Big data, characteristics, data models and

	Cluster File System using Spark • CO2- Ability to analyse the architectural elements of big data and hadoop framework • CO3- Ability to design NoSQL structures like MongoDB, Cassandra, Pig and Hive for processing and aggregating logs in the database. • CO4- Ability to demonstrate the usage of MongoDB and Cassandra database models for big data along with experiment conduction using HDFS and Map Reduce • CO5- Ability to design and implement big data analytics for real time dataset available on big data application • CO6- Ability to make an effective oral presentation and documentation on the data analytics implemented **Professional Ethics for Engineers-16CS7HSHS2** • **CO1-** Ability to apply the knowledge of professional ethics required to be followed in different organisation structures. • CO2- Ability to analyse and address ethical problems arising from various case studies. • CO3- Ability to resolve moral and ethical issues concerning environment and society. **Software Quality Metrics-16CS7CESQM** • **CO1-** Ability to apply software metrics and measurements to the internal and external attributes of software product to assess software quality • CO2- Ability to analyse and predict the quality of the software using Software quality metrics and models • CO3- Ability to evaluate the quality of the software system using metrics tools **Project Phase1-16CS7DCPP1** • **CO1-** Ability to identify a real life/engineering problem, utilize prior knowledge and conduct extensive investigation, across diverse sources, in addressing the • CO2- Competence in applying the software engineering principles in planning,

	formulating an innovative design/ approach and computing the requirements • CO3- Ability to plan, monitor, and manage project schedule, resources, and work assignments to ensure timely completion • CO4- Perform professionally—as a team member, accepting responsibility, taking initiative, and providing leadership necessary to ensure project success. • CO5- Ability to use formal and informal communications with team members and guide, make presentations and prepare technical document. • CO6- Ability to provide solution within the context of legal framework addressing the societal and environmental concerns and upholding ethical issues. **8th SEMESTER** **Management and Entrepreneurship-17CS8HSMAE** • **CO1-** Ability to apply Engineering knowledge to effectively exhibit managerial skills at different levels of management in a global context • CO2- Ability to demonstrate the critical awareness of the principles and importance of entrepreneurship • CO3- Ability to Examine the process of creating and managing a new business venture and prepare a business plan for any identified business problem **GREEN COMPUTING -16CS8DCGCT** • **CO1-** Ability to apply knowledge of fundamentals of Green Computing for various Business Assets • CO2- Analyse various strategies that can reduce the environmental impact of usage of computers to make business more energy efficient and green compliant. • CO3- Demonstrate/Conduct investigation on Novel Green Computing Frameworks for various Business assets • CO4- Ability to make effective Oral

	presentation on various Green IT strategies **Internship/Technical Seminar-16CS8DCINT** • **CO1-** Ability to apply domain knowledge during the course of internship • CO2- Ability to develop/implement the solutions with appropriate techniques, resources and contemporary tools. • CO3- Ability to work independently and in a collaboration/multidisciplinary environment • CO4- Ability to allocate time effectively and manage to complete the work allotted within appropriate time • CO5- Ability to exhibit integrity and ethical behavior while carrying out the internship and for the preparation of internship report • CO6- Ability to demonstrate effective oral and written communication skills **Project Phase 2-16CS8DCPP2** • **CO1-** Ability to apply the software engineering principles in planning, formulating an innovative design/ approach and computing the requirements appropriate to chosen topic within the context of legal, societal and environment constraint. • CO2-Ability to apply the concepts of mathematics, science and engineering to implement the project and draw conclusions out of the results, while exhibiting integrity and ethical behavior in engineering practice • CO3- Ability to monitor, manage project schedules, resources and work assignments to ensure timely completion. • CO4- Ability to test and defend performance of the implemented project and understand the implication of the solution. • CO5- Ability to perform individually as well as in a team, accepting responsibility, taking initiative, and providing leadership, necessary to ensure project success. • CO6- Ability to use formal and informal communications with team members and guide, make presentations and prepare technical document.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Name of the Programme	**MTech in Computer Science and Engineering**
Programme Educational Objectives (PEOs)	PEO1: Able to excel professionally by adapting to the dynamic needs of Industry, Academia and Research in the field of Computer Science and Engineering. PEO2: Able to practice and promote computing technologies for societal needs. PEO3: Able to contribute to advancement of computer technology by means of research and lifelong learning.
Programme Outcomes (POs)	PO1- An ability to independently carry out Research / Investigation and development work to solve practical problems PO2- An ability to write and present a substantial technical Report / Document PO3- An ability to demonstrate mastery in the area of Computer Science and Engineering, at a level higher than under graduate program in Computer Science and Engineering.
Course Outcomes (COs)	**1st SEMESTER** **Mathematical Foundation of CS-18CSCSBSMF** • **CO1-** Independently carry out study of Recent Trends in distribution functions and present results for computing problem or application • CO2- Conduct experiments to arrive at expected outcome for given application using statistical techniques • CO3- Demonstrate In-depth knowledge in Mathematical /statistical theories **Advanced Data Structures-18CSCSPCAD** • **CO1-** Define and explain concepts related to data structure. • CO2- Investigating Data Structure/Trees of a Data Structure Problem • CO3- Apply the data structure algorithm and tree to solve complex problem. • CO4- Analyse different algorithms/trees in

	data structure. • CO5- Conducting experiments of data structure concepts using modern tool/simulation. **Soft Computing-18CSCSPCSC** • **CO1-** Review and make effective oral presentation on current trends and prepare a report on Soft Computing techniques. • CO2- Conduct experiments to arrive at expected outcome for given application using soft computing techniques. • CO3- Demonstrate In-depth knowledge in soft computing by performing mathematical analysis. **Machine Learning-18CSCSPEML** • **CO1-** Demonstrate scholarship of knowledge in the application/analysis of Machine Learning algorithms to solve various types of learning tasks • CO2- Implement Machine Learning Techniques and present a technical report/document. • CO3- Carry out research/Investigation for a given Machine Learning Technique **Cloud Computing-18CSCSPECC** • **CO1-** Present and document current trends and issues in Cloud Computing technology. • CO2- Apply the knowledge of cloud technology to demonstrate the working principles of cloud for different application. • **CO3-** Analyse concept of cloud computing technology in usage of various application. • CO4- Conduct practical experiments for demonstrating cloud computing technology. • CO5- Understand the concepts of cloud computing technology for different application. **Research Methodology and IPR-18ALLPICRM** • **CO1-** Write and present a substantial technical report/document • CO2- Demonstrate a degree of mastery over the area of specialization **2nd SEMESTER** **Advanced Computer Networks-18CSCSPCAC**

	• **CO1-** Develop technical report for advance topics in networking. • CO2- Apply and analyse various network protocols, congestion control mechanism and network security algorithms / protocols. • CO3- Implement and demonstrate routing and congestion control algorithms / methods. **Advanced Algorithms-18CSCSPCAA** • **CO1-** Apply algorithms to solve problems in graph theory and string matching algorithms • CO2- Analyze time complexity of algorithms • CO3- Design and implement FFT algorithms **Agile Technology-18CSCSPCAT** • **CO1-** Engage in independent study to prepare a Technical document to address current trends in Agile technology • CO2- Demonstrate In-depth knowledge in Agile technologies/theories/ practices • CO3- Demonstrate scholarship of knowledge to provide critical analysis of agile technologies **Internet Of Things-18CSCSPEIO** • **CO1-** Oral presentation of IoT applications and analytics of the result obtained • CO2- Perform triggering of Raspberry PI-interfaces with gadgets using Python • CO3- Demonstration of how mobile devices can be sink with IoT devices for certain applications • CO4- Experiment on how IoT data can be moved to cloud for analytics purpose • CO5- Understand the concepts on how IoT has its impact on present real time situation. **Deep Learning-18CSCSPEDL** • **CO1-** Demonstrate scholarship of knowledge in the application/analysis of Deep Learning algorithms to solve various types of learning tasks, NLP and Computer Vision tasks • CO2- Implement Deep Learning Techniques and present a technical report/document. • CO3- Independently work for a given problem so as to find the applicability of the Deep learning techniques **Artificial Intelligence-18CSCSOEAI** • **CO1-** Demonstrate the understandability of

	Artificial intelligence concept and develop technical reports • CO2- Analyze the modern view of AI as the study of agents and investigate various AI search Models and Generic search strategies. • CO3- Design Logics for representing Knowledge and learning algorithms for improving the performance of AI systems. **3rd SEMESTER** **Internship-16CSCSPCIN** • **CO1-** Ability to Apply domain knowledge in proposing solution for IT problem • CO2- Ability to develop/implement the design with appropriate techniques, resources and contemporary tools and deliver solution with stipulated planning • CO3- Ability to work independently. • CO4- Ability to work in collaboration/multidisciplinary environment. • CO5- Ability to exhibit integrity and ethical behavior during preparation of Technical document/Report/ development of solution • CO6-Ability to use formal and informal communications with guide, make presentations and prepare technical document **Project Work- Phase-I-16CSCSPCP1** CO1: Engage in independent study to research through literature and consolidate and comprehend to formulate the Engineering problem to offer solution to societal/environmental/ IT industry problem. CO2: Identify the necessary Engineering concepts, Technology, algorithms and modern tools to solve the problem. CO3: Develop requirements and apply the identified concepts to design solution for a set of requirements CO4: Prepare Gantt chart / estimate cost of project/ Analysis of project based on various parameters and resources (Power, Bandwidth, Time Complexity)

	4th SEMESTER **Project work- Phase-II and III-16CSCSPCP2** CO5: Implement algorithms, and/or techniques that contribute to the software solution of the project using identified tools. CO6: Demonstrate the standards/norms/ethical practices during implementing the solution CO7: Analyse and interpret experimental results/Test and validate the conformance of the developed prototype against the original requirements of the problem and exhibiting integrity and ethical behavior in engineering practice. CO8: engage in effective communication through presentation of project work, prepare technical reports, Poster document and paper publication **Technical Seminar-16CSCSPCTS** **CO1-** conduct literature surveyand identify topic/concepts. CO2- analyze methodology/technique or algorithm. CO3- analyze different case studies/senarios/tools in the selected concept. CO4- communicate and prepare documentation/reports effectively. CO5- exhibit reflective learning and work independently

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DEPARTMENT OF TELECOMMUNICATION ENGINEERING

Academic Year 2019-20

Name of the Programme	B.E. in **Telecommunication Engineering**
Programme Specific Outcomes (PSOs)	1. **Build Electronic Systems**: formulate the problem, design, implement, analyze and demonstrate a feasible solution to the problem, using suitable electronic components 2. **Build Telecommunication Systems**: design, implement, analyze and demonstrate the telecommunication system to receive and(or) transmit signals through the specified channel 3. **Simulate Systems:** develop, test, analyze and demonstrate algorithms to simulate Electronic systems/ Telecommunication systems/ Networking protocols using the specified Engineering Tool
Programme Outcomes (POs)	PO1 to PO12
PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	
PO2: Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	
PO5: Modern Tool Usage : Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations	
PO6: 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.	
PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.	
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	
PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: 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
Course Outcomes (COs)
Course : Electrical Circuit Analysis
CO1: Ability to **define**, **understand** and **explain** concepts related to electrical circuits
CO2: Ability to **apply** the knowledge of network theorems to the given electrical circuit to obtain the desired parameter
CO3: Ability to **analyse** given electrical circuit to arrive at a suitable conclusion
CO4: Ability to **conduct** experiments to demonstrate the specified concept/ application of electrical circuit on the Multisim platform
CO5: Ability to **analyse** the given electrical circuit on the Multisim platform to compute the desired parameter
Course : Analog Electronic Circuits
CO1: Ability to **define** ,**understand** and **explain** concepts related to diodes and transistors (BJTs and MOSFETs)
CO2: Ability to **apply** the knowledge of network theorems to the given analog electronic circuit to obtain the desired parameter
CO3: Ability to **analyze** given analog electronic circuit to arrive at a suitable conclusion
CO4: Ability to **design** analog electronic circuit for given application and specifications
CO5: Ability to **design and conduct experiment** using analog electronic circuit for given application and specifications
CO6: Ability to **conduct** experiments to verify THREE parameters of the datasheet of the given electronic component
CO7: Ability to implement a **mini-project** to implement and demonstrate the **given problem** using suitable analog electronic components
Course : Digital Electronic Circuits
CO1: Ability to **understand, define and explain** the fundamental concepts of Digital Electronic circuits
CO2: Ability to **apply** the concepts and simplification methods of Digital Electronic circuits for the specified application

CO3: Ability to **analyse** digital electronic circuit and arrive at suitable conclusions
CO4: Ability to **design** a digital circuit to meet given specifications
CO5: Ability to **conduct** experiments to demonstrate the specific application of digital electronics using suitable digital ICs/ Multisim
CO6: Ability to **build** the given Gate/Flip-Flop using suitable analog electronic components on the Multisim platform and validate its performance
CO7: Ability to **conduct** experiments to verify few parameters from the datasheet of the given digital IC
CO8: Ability to implement and demonstrate the specified **mini-project** using suitable digital electronic components
Course : Field Theory
CO1: Ability to **define, understand**, and **explain** concepts of static and time varying Electric and Magnetic Fields, Maxwell's equations, wave propagation in different media
CO2: Ability to **apply** various properties/ laws/theorems of Electric and Magnetic Fields to obtain the specified parameter
CO3: Ability to **analyse** the given static and time varying Electric and Magnetic Fields to arrive at a suitable solution
CO4: Ability to **develop** the code in any programming language to demonstrate specified concepts of static and time varying Electric and Magnetic Fields
CO5: Ability to **engage in independent study** and make an **oral presentation** on the applications/ hazards of **Electromagnetic radiation**
Course : Sensors and Measurements
CO1: Ability to **understand, define and explain** the concepts of Sensors and Measurements
CO2: Ability to **apply** the concepts of Sensors and Measurements to obtain the desired parameter
CO3: Ability to **conduct** experiments to demonstrate the specified concept/ application of Sensors
CO4: Ability to **conduct** experiments to verify few parameters from the datasheet of the given sensor
CO5: Ability to **build** the specified Instrument using Multisim
CO6: Ability to **engage in independent study** and make an **oral presentation** on the hazards of E-waste on **Environment**
Course : Control Systems
CO1: Ability to **define, understand and explain** concepts related to linear control systems
CO2: Ability to **apply** the concepts of control systems and signal processing to obtain the specified parameter/ system function
CO3: Ability to **analyze** the given linear control system and arrive at a suitable conclusion

CO4: Ability to **conduct experiments** to demonstrate concepts related to linear control systems using the engineering tool: Matlab/ Simulink
CO5: Ability to **design** Compensators and controllers to meet given (time/frequency domain) specifications
Course : Linear Integrated Circuits
CO1: Ability to **define** ,**understand** and **explain** concepts of linear integrated circuits (LIC)
CO2: Ability to **apply** the concepts of LIC to obtain the desired parameter
CO3: Ability to **analyze** given LIC to arrive at a suitable conclusion
CO4: Ability to **design** LIC for given application and specifications
CO5: Ability to **conduct** experiments to demonstrate the specified concept/ application of LIC
CO6: Ability to **conduct** experiments to verify THREE parameters of the datasheet of the given LIC/Component
CO7: Ability to **design and conduct experiment** using LIC for given application and specifications
CO8: Ability to **conduct experiments** using discrete components, repeat the same using the Multisim tool and make a comparative study
CO9: Ability to implement a **mini-project** to implement and demonstrate the given problem using suitable LICs and components
CO10: Ability to engage as a member of a team to prepare a comparative study (specifications, applications, cost) of various LICs available in market
Course : Microcontrollers
CO1: Ability to **understand** and **explain** various concepts of microprocessors and microcontrollers
CO2: Ability to **apply** the concepts of microprocessors and microcontrollers to obtain the desired parameter
CO3: Ability to **develop the code (**assembly/C) to perform the specified task
CO4: Ability to **design** and develop the logic to interface external memory and peripherals
CO5: Ability to **analyse/debug** the given code
CO6: Ability to **conduct experiments** by developing the code **(**assembly/C) to perform the specified task
CO7: Ability to **conduct investigations** to **analyse/debug** the given code
CO8: Ability to implement a **mini-project** to develop solutions to the given problem using 8051 and suitable sensors
CO9: Ability to engage as a member of a team to prepare a comparative study (specifications, applications, cost) of various microcontrollers available in market
Course : Signals and Systems

CO1: Ability to **define, understand and explain** concepts of Signals and Systems
CO2: Ability to **apply** the concepts of signals and systems processing to obtain the specified parameter/ system function
CO3: Ability to **analyze** the given signal/ system and arrive at a suitable conclusion
CO4: Ability to **conduct experiments** to demonstrate concepts related to signals and systems using the engineering tool: Matlab/ Multisim
CO5: Ability to conduct experiments to identify the components in the given circuit block (sealed)
CO6: Ability to **conduct experiments** to analyze the given system using the engineering tool: Matlab/ Multisim
CO7: Ability to **engage in independent study** and make an **oral presentation** on the applications of Signal Processing to **Society**
Course : VLSI Design
CO1: Ability to **define, understand** and **explain** concepts of nMOS and CMOS technology.
CO2: Ability to **apply** the knowledge of VLSI to fabricate the MOS circuits, **illustrate** different CMOS logic structures, subsystems and memory elements, **calculate** rise time and fall time estimations.
CO3: Ability to **analyze** the monochrome layout and stick diagrams of MOS technology and CMOS logic structures and subsystems, **deduce** appropriate testability vectors for the given parameters.
CO4: Ability to **conduct experiments** using VLSI tools for a given application/problem statement.
CO5: Ability to **analyze the given** VLSI simulation block and arrive at the application/problem statement.
CO6: Ability to implement a **mini-project** to develop the specified application using VLSI tools
Course : Discrete Time Signal Processing
CO1: Ability to **define, understand and explain** concepts related to discrete time signals and systems.
CO2: Ability to **apply** the knowledge of signal processing to **obtain** the time and frequency domain representation of linear discrete time signals and systems (LTI).
CO3: Ability to **analyze** the given LTI system for stability, and realiability.
CO4: Ability to **design** discrete LTI systems to meet given specifications.
CO5: Ability to **conduct experiments** to demonstrate concepts related to discrete LTI systems using the engineering tool: Matlab.
CO6: Ability to **conduct experiments** to demonstrate concepts related to discrete LTI systems using the Digital Signal Processors.
CO7: Ability to **design, formulate, implement and demonstrate** an application of discrete time system concepts through an Open-**Ended experiment** for an

audio/image/video/data signal.
Course : Analog Communication
CO1: Ability to **define, understand and explain** concepts of convolution, correlation, random variables, time and frequency domain representation of analog communication systems.
CO2: Ability to **apply** the knowledge of signal processing to obtain the time and frequency domain representation, Figure of Merit of analog communication systems.
CO3: Ability to **analyze** the waveforms related to analog communication.
CO4: Ability to **design** analog communication systems to meet given specification.
CO5: Ability to **conduct experiments** to demonstrate concepts related to analog communication using suitable electronic components/Engineering Tool (Matlab).
CO6: Ability to make an **effective oral presentation** on broadcast standards, contribution to society, impact on health, effect on environment.
CO7: Ability to perform in a team to build **an AM/FM** receiver using discrete components and simulation tool (Matlab)
Course : Computer Communication Networks-I
CO1: Ability to **define, understand and explain** concepts related to Telecommunication Networks.
CO2: Ability to **apply** the knowledge of engineering fundamentals to **obtain** the traffic parameters (Grade of Service, Blocking probability, congestion) of the network.
CO3: Ability to **analyze** the given network parameters.
CO4: Ability to **design** a switching network to meet given specifications.
CO5: Ability to **conduct experiments** to demonstrate concepts related to telecommunication networks using the Engineering Tool MATLAB.
CO6: Ability to perform in **a team** to prepare a report and make an **effective oral presentation** of the study on topics related to Networks protocols, effect on environment, contribution to society.
Course : Fundamentals of CMOS VLSI
CO1: Ability to **define, understand** and **explain** concepts of nMOS and CMOS technology.
CO2: Ability to **apply** the knowledge of VLSI to fabricate the MOS circuits, **illustrate** different CMOS logic structures, subsystems and memory elements, **calculate** rise time and fall time estimations.
CO3: Ability to **analyze** the monochrome layout and stick diagrams of MOS technology and CMOS logic structures and subsystems, **deduce** appropriate testability vectors for the given parameters.
CO4: Ability to **conduct experiments** using VLSI tools for a given application/problem statement.
CO5: Ability to **listen** and **comprehend** audio/video lectures related to VLSI concepts.
Course : Linear Control Systems
CO1: Ability to **define, understand and explain** concepts related to linear control systems.
CO2: Ability to **apply** the knowledge of signal processing o obtain the Bode plot, Nyquist

plot, Polar Plot, Root locus, state-space representation of the given system.
CO3: Ability to **analyze** the given linear control system for realizability and stability.
CO4: Ability to **design** controllers to meet desired specifications using time and frequency domain representation.
CO5: Ability to **conduct experiments** to demonstrate concepts related to linear control systems using the engineering tool: MATLAB/LabVIEW.
Course : Digital System Design
CO1: Ability to **understand**, define the concepts and advanced features of VHDL to design a digital circuit
CO2: Ability to **apply** PLD concept to design a digital system
CO3: Ability to **design** a digital system for arithmetic operations
CO4: Ability to **realize** and **analyze** digital circuits using SM charts
CO5: Ability to **conduct experiments** to simulate, synthesize and implement digital systems using industry standard CAD tools
Course : Operating Systems
CO1: Ability to **understand and explain** the structures of operating systems, file-system, inter-process communication and memory management.
CO2: Ability to **identify** different scheduling policies and threads for process operations.
CO3: Ability to **analyze** and obtain solution for prevention and avoidance of deadlock in system.
CO4: Ability to **conduct experiments on** scheduling, memory management, file system using C/Unix
Course : Simulation Laboratory - III
CO1: Ability to **understand** basic programming concepts of the engineering tool Simulink, Multisim.
CO2: Ability to **develop** Simulink code to implement basic mathematical concepts, signal processing concepts.
CO3: Ability to **obtain** the pole-zero plot, frequency response, transient response of a given system and hence classify the system.
CO4: Ability to **design, implement** and **Validate** the **VLSI** circuits using Multisim Tool.
CO5: Ability to **implement** and **analyze** the given OS / VHDL system for specified parameters.
CO6: Ability to perform in a **team** to develop a tool-box using Matlab for a course (Mathematics/control systems/ Signal processing / Analog Communication)
CO7: Ability to perform in a **team** to develop the Analog Communication Link using Simulink.
Course : Digital Communication
CO1: Ability to **define, understand and explain** concepts related to digital communication
CO2: Ability to **apply** the knowledge of mathematics and signal processing to various blocks of the digital communication system
CO3: Ability to **analyze** the given block/waveform of the digital communication system

CO4: Ability to **conduct experiments** to demonstrate concepts related to digital communication using discrete electronic components
CO5: Ability to **conduct experiments** to demonstrate concepts related to digital communication using the engineering tool: LabVIEW
CO6: Ability to perform in a team to build **the complete digital communication system** for transmitting audio/data/image and obtain the performance parameters (using discrete components or an engineering tool)
Course : Transmission Lines and Antennas
CO1: Ability to **define, understand, and explain** concepts of transmission lines involving primary and secondary constants ,Time varying fields to obtain the radiation pattern and related parameters of different antennas
CO2: Ability **to apply** various properties/laws/theorems/ to **solve / derive** transmission line problems and **obtain** parameters of different antennas.
CO3: Ability to **analyze** the given specifications of different types of transmission lines and antennas in various configurations/ distributions.
CO4: Ability to **design** solutions to meet the given specifications of transmission lines and antennas.
CO5: Ability to **conduct experiments** to design and analyze concepts related to transmission lines and antennas using HFSS
CO6: Ability to perform in **a team** to prepare a report and make an **effective oral presentation** of the study on topics related to antenna applications/ radiation hazards/ transmission lines/ broadcast standards/ EMC-EMI/ any other
Course : Computer Communication Networks – II
CO1: Ability to **define, understand and explain** concepts related to network, transport and application layer
CO2: Ability to **apply** the knowledge of communication and coding to telecommunication networks
CO3: Ability to **analyze** the given network systems parameters
CO4: Ability to **conduct experiments** to demonstrate networking concepts using the engineering tool: Qualnet / Matlab
CO5: Ability to perform in **a team** to prepare a report and make an **effective oral presentation** of the study on application of communication protocols to Railways/ Landing Systems/ Power Systems/ Automotives/ Positioning Systems / any other
Course : Information Theory and Coding
CO1: Ability to **define, understand and explain** concepts related to information theory and coding
CO2: Ability to **apply** the knowledge of probability and source encoding algorithms to **obtain** the information of analog and discrete message sources
CO3: Ability to **analyze** Convolution codec
CO4: Ability to **design** the Block and Convolution codes for a given channel
CO5: Ability to **conduct experiments** to demonstrate concepts related to information theory and coding using the engineering tool: LabVIEW/ Matlab

CO6: Ability design, formulate, implement and demonstrate an application of coding theory through an **Open-Ended experiment** for transmission of audio/data signal using LabVIEW/ Matlab/ VHDL/ any other
Course : Simulation Laboratory - IV
CO1: Ability to **understand** basic programming concepts of the High Frequency Structure Simulation (HFSS) Tool and LabVIEW
CO2: Ability to **develop HFSS program** to implement basic antennas structures
CO3: Ability to **obtain** the radiation pattern, antenna gain, S-parameters, return loss of the antenna, antenna array
CO4: Ability to **design, implement** and **validate** the antenna structures using HFSS
CO5: Ability to **design, implement** and **demonstrate** the Block/Convolution codes using Matlab/Multisim/LabVIEW
CO6: Ability to **formulate, implement** and **demonstrate** an application of coding theory through an **open-ended experiment**
Course : Image Processing
CO1: Ability to **understand** and **explain** concepts of digital image processing.
CO2: Ability to **apply** the knowledge of image processing techniques to enhance the quality of gray scale and colour image, restore the degraded image, **illustrate** different segmentation principles, and **solve** problems based on different image processing transforms.
CO3: Ability to **analyze** the distance relationship between pixels, **evaluate** Histogram equalization on gray scale and colour image, **deduce** filter operations on the image, **analyze** image segmentation and image transforms.
CO4: Ability to **conduct experiments** using MATLAB for a given application/problem statement.
CO5: Ability to listen and comprehend audio/video lectures related to image processing concepts.
Course : C++ and Data Structures
CO1: Ability to **understand** the programming concepts for data structures
CO2: Ability to **apply** the knowledge of Engineering mathematics and programming skills to develop efficient codes in C++
CO3: Ability to **analyze** abstract object and real object using class
CO4: Ability to **design** programming solutions with operator overloading and memory management
CO5: Ability to work as an individual and thereby **conduct experiments** using any C compiler for a given application/problem statement.
CO6: Develop, test, analyze and demonstrate applications using C++ and Data structures through an **Open-Ended Experiment**
Course : Cryptography and Network Security
CO1: Ability to **define, understand and explain** concepts related to network security
CO2: Ability to **apply** the knowledge of mathematics to cryptography
CO3: Ability to **analyze** the given security systems parameters

CO4: Ability to perform as an individual, prepare a report and make an **effective oral presentation** on applications of network security protocols of communication system, satellite systems , any other.,
Course : Microwave and Radar
CO1: Ability to **define, understand and explain** concepts related to microwave and RADAR
CO2: Ability to **apply** the knowledge of electromagnetic theory for propagation/transmission of microwaves
CO3: Ability to **analyze** the behavior of microwave active devices and passive devices using S parameters
CO4: Ability to **conduct experiments** to measure the losses, power, VSWR, coupling factor, isolation, directivity, S-parameters (using microwave bench/simulation tool)
CO5: Ability to engage in independent learning, submit a report and use ICT for **effective presentation** on the study on topics related to microwave link / standards / radiation hazards / specifications / applications / impact on society/environment
Course : Multimedia Communication
CO1: Ability to **understand** and **explain** concepts of multimedia communication.
CO2: Ability to **apply** knowledge of analog and digital communication to multimedia data.
CO3: Ability to **analyze** various communication networks, **derive** text encoding, **evaluate** different image compression schemes and **analyze** audio/speech/video frames.
CO4: Ability to function effectively as an individual and as a team member to **conduct experiments** using MATLAB for a given multimedia application/problem statement.
CO5: Ability to work as an individual/ in a team to **identify, test, analyze** and **demonstrate** Multimedia protocols as a mini-project using modern engineering tools.
Course : Wireless Communication
CO1: Ability to **define, understand** and **explain** concepts related to wireless communication
CO2: Ability to **apply** the knowledge of communication and coding to wireless communication
CO3: Ability to **analyze** the given parameters for different propagation models of wireless networks
CO4: Ability to **conduct experiments** to demonstrate concepts of wireless communication using the engineering tool such as QUALNET / MATLAB
CO5: Ability to perform in a team to prepare a report and make an effective **oral presentation** of the study on topics related to Networks protocols, contribution of wireless systems to the society and its effect on environment
Course : Project for Community Service
CO1: Ability to **apply** and **analyze** the engineering concepts to solve the identified research work through literature survey.
CO2: Ability to arrive at an exhaustive list of available **modern engineering tools,** and select the tool for implementing the identified research work
CO3: Ability to **design** systems using hardware components/ software tools considering

health, safety and societal needs and **validate** the results of the identified work leading to publications
CO4: Ability to abide by the norms of **professional ethics** and meet societal and environmental needs
CO5: Ability to perform in the **team**, contribute to the team and mentor/lead the team
CO6: Ability to **communicate effectively** through presentation and demonstration of the project and preparation of the report and video.
CO7: Ability to apply the principles of **project management** and **finance** during the implementation of the project
CO8: Ability to function effectively as an individual to engage in **independent learning**
Course : Optical Fiber and Satellite Communication
CO1: Ability to **define**, **understand** and **explain** concepts of Optical Fiber and satellite communication system
CO2: Ability to **apply** the knowledge of electromagnetic theory/ray theory to study the technologies of Fiber Optic Communication and satellite communication
CO3: Ability to **analyze** power budget for a given communication link
CO4: Ability to **interpret** sample satellite data and arrive at suitable conclusion
CO5: Ability to function effectively as an individual or as a team member to **conduct experiments** using optical fiber kit.
Course : Speech Processing
CO1: Ability to **define, understand**, and **explain** discrete time model of the speech production and short time processing of the speech
CO2: Ability to **solve** LPC equations for speech communication and **obtain** complex Cepstrum of speech for pitch estimation
CO3: Ability to **analyze** and **synthesize** the speech in frequency domain through short time Fourier transform
CO4: Ability to function effectively as an individual or as a team member to **conduct experiments** using modern engineering tools for a given Speech processing problem.
CO5: Ability to perform in a **team** to implement an open-ended experiment
Course : Low Power Microcontroller
CO1: Ability to **understand** and **explain** the concepts of low power microcontroller, architecture, addressing modes, timer modes, displays, low power modes, serial communication
CO2: Ability to **identify** the addressing modes, **write** and execute assembly and C codes
CO3: Ability to **debug** and **analyze** the assembly and embedded C code for variants of MSP430 microcontroller
CO4: Ability to identify the IDE to **conduct experiments** using assembly and embedded C for implementing low power applications on MSP430 hardware.
CO5: Ability to perform in a team/individual to prepare a report and make an effective **oral presentation** of the study on application of low power applications of MSP430
Course : Sustainable Telecommunication Networks

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DEPARTMENT OF TELECOMMUNICATION ENGINEERING

CO1: Ability to **understand** and **explain** the need for sustainability, role of regulatory bodies, radiation hazards and revenue models for telecommunication networks
CO2: Ability to **apply** the knowledge of radiation hazards to minimize the effect on human health and environment
CO3: Ability to **apply** the Knowledge of finance management to arrive at effective revenue models for telecommunication networks
CO4: Ability to engage in independent learning, submit a report and use ICT for **effective presentation** on the study on topics related to, Awareness on Mobile Tower Radiation & Its Impacts On Environment, human health and protection from radiation hazards
Course : IPR & Cyber Law
CO1:Apply technical concepts of IPR and Cyber Law to access societal, health, safety issues and continue responsibilities relevant to the professional engineering practices
CO2:Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law
CO3: Ability to **apply** ethical principle to obtain Intellectual property Rights like Patents, Copyright & Trademarks and Action taken due to unethical Telecom practices in Cyber law
CO4: Ability to work as an **individual** / in a **team** to effectively **communicate** Intellectual Property rights and Cyber Law leading to improvement in team work and leadership qualities.
Course : Project Management and Finance
CO1: Ability to **define, understand** and **explain** concepts related to Project management and Finance.
CO2: Ability to **apply** the knowledge of project Management and Finance for success of projects
CO3: Ability to **analyze** financial feasibility ,cost estimation and financing of projects
CO4: Ability to **design** project work system
CO5: Ability to use **modern tools** for project scheduling and monitoring aspects of project management.
CO6: Ability to engage in **independent learning**, submit a report and use ICT for effective presentation on the study on topics related to Management of telecommunication based Projects.
Course : Satellites: Principles & Applications
CO1: Ability to **define, understand** and **explain** Satellite Principles and applications.
CO2: Ability to **apply** the knowledge of Physics, mathematics, electronics and communication for satellites
CO3: : Ability to **analyze** orbital parameters, modulation schemes, multiple access methods and satellite links
CO4: Ability to use **tools** for studying satellite applications
CO5: Ability to engage in **independent learning**, submit a report and use ICT for effective presentation of the study on assigned topics related to applications of satellite communication/ standards/ related hazards
Course : Seminar: Based on Internship/Technical Paper

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Autonomous Institute, Affiliated to VTU

DEPARTMENT OF TELECOMMUNICATION ENGINEERING

CO1: Ability to develop written and oral **communication skills** in both technical and non-technical environment, and use ICT for effective presentation of the study / internship
CO2: Ability to function effectively as an **individual** to identify the mathematical concepts, science concepts, engineering concepts and **modern engineering tools** necessary to communicate the identified study / internship
CO3: Ability to engage in **independent study** to research literature and understand Telecommunication engineering trends in the identified study
CO4: Ability to **apply** and **analyze** the knowledge of Telecommunication and Electronics engineering concepts to effectively communicate the results from various publications
CO5: Ability to emphasize the need and abide by **professional ethics**
CO6: Ability to emphasize the role of Telecommunication and Electronics concepts on **environmental, cultural** and **societal** aspects.
Course : Project Work
CO1: Ability to **apply** and **analyze** the engineering concepts to solve the identified research work through literature survey.
CO2: Ability to arrive at an exhaustive list of available **engineering tools,** and select the tool for implementing the identified research work
CO3: Ability to **design** systems using hardware components/ software tools considering **health, safety** and **societal needs** and **validate** the results of the identified work leading to publications
CO4: Ability to abide by the norms of **professional ethics** and meet societal and environmental needs
CO5: Ability to perform in the **team**, contribute to the team and mentor/lead the team
CO6: Ability to **communicate effectively** through presentation and demonstration of the project and preparation of the report and video.
CO7: Ability to apply the principles of **project management and finance** during the implementation of the project
CO8: Ability to function effectively as an individual to engage in **independent learning**

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

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DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Academic Year 2019-20

Name of the Programme	B.E. in Information Science and Engineering
Programme Specific Outcomes (PSOs)	• PSO1: Apply and Analyze the concepts of Computer Networks to provide solution for evolving needs in Information Technology. • PSO2: Demonstrate knowledge of Software Engineering and Data Science with competence in programming languages to solve real-world problems. • PSO3: Apply principles of information systems in the field of engineering for proficient solutions.
Programme Outcomes (POs)	**PO1 to PO12** PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. PO5: 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. PO6: 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. PO7: 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.

	PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12: 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.
Course Outcomes (COs) **- 3rd and 4th Semester (New Scheme)**	**19MA3BSSDM - STATISTICS AND DISCRETE MATHEMATICS** CO1: Use graphs as representation tool in network analysis. CO2: Demonstrate an understanding of the basic concepts of combinatorics. CO3: Apply the concepts for probability, Statistics and Queuing theory. **19IS3ESOPS - OPERATING SYSTEM** CO1: Understand the basic concepts of operating system structures, services and functionalities. CO2: Apply various concepts to solve problems related to synchronization, deadlocks, memory management, CPU scheduling. CO3: Compare different algorithms of CPUscheduling, Page replacement, storage management and disk scheduling. CO4: Analyze appropriate algorithm for the given CPU processes, deadlock occurrences and memory management. CO5: Demonstrate the algorithms used for CPU scheduling and disk scheduling using OS sim.

	19IS3PCDSC - DATA STRUCTURES WITH C CO1: Apply principles of Data Structures for solving problems. CO2: Analyse and Develop operations on linear and non-linear data structures. CO3: Design and formulate various method of organizing data. CO4: Conduct experiments to implement operations like searching, insertion, deletion, traversal mechanism on various data structures. CO5: Demonstrate data structure coding skills on a competitive programming platform. CO6Make effective presentations on the implementations of applications on data structures. **19IS3PCOOP - OBJECT ORIENTED PROGRAMMING USING C++** CO1: Comprehend the basic concepts of object oriented programming with C++. CO2: Apply the concepts of data abstraction, encapsulation, polymorphism, inheritance, and templates and file handling. CO3: Identify the usage of reusability, polymorphism and exception handling for solving problems. CO4: Develop solutions using object oriented programming concepts for a given problem. CO5: Conduct experiments for the concepts of function overloading, operator overloading, exception handling, templates & file functionalities using modern tools. **19IS3PCDLD - DIGITAL LOGIC DESIGN** CO1: Comprehend basic logic gates, combinational logic circuits and sequential logic circuits. CO2: Apply digital logic to simplify boolean equations and functions. CO3: Design synchronous and asynchronous counters. CO4: Analyze combinational and sequential logic circuits. CO5: Prototype synchronous and asynchronous sequential circuits.

	19IS3PCCOA - COMPUTER ORGANIZATION AND ARCHITECTURE CO1: Comprehend the concepts of basic architecture of a computer, instruction execution, interrupts, bus structures, memory organization, arithmetic unit operations and Pipelining concepts. CO2: Apply the types of addressing modes, stack operations, subroutines, types of memory mapping, and arithmetic operations and data transfer methods on various problems. CO3: Analyse instruction set architecture, interface circuits, arithmetic and logic circuits, pipeline performance. CO4: Identify the control signals, types of interrupts, bus structures, memory, arithmetic operations and microcontrollers. CO5: Make an effective communication and presentation in a team on different processor architecture. **19IC3HSCPH - CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS** CO1: Understand and explain the significanceof Indian Constitution as the Fundamental Law of the Land. CO2: Analyse the concepts and ideas of Human Rights. CO3: Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public. **19IS3PWWAD - WEB APPLICATION DEVELOPMENT** CO1: Apply the knowledge of HTML, CSS and Scripting technologies to develop interactive web applications. CO2: Analyze front-end web coding languages to add dynamic content, animation and effects to websites. CO3: Identify client side and server side scripting technologies. CO4: Design an interactive website(s) with regard to issues of usability, accessibility and Standards. CO5: Develop web application in a Team.

	CO6: Create device independent web pages based on user specific requirements and constraints using Integrated Development tools (Webstorm/VS Code/Atom). **19MA4BSLIA - LINEAR ALGEBRA** CO1: Apply the concepts of Matrices to linear systems and vectors spaces. CO2: Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra. CO3: Apply the concepts of inner products to matrix decomposition. **19IS4PCDBM - DATABASE MANAGEMENT SYSTEM** CO1: Comprehend the fundamentals of database management systems, ER model, relational algebra, SQL, NoSQL, design principles and Transaction management. CO2: Apply database management concepts, principles, Entity – Relationship model, relational algebra concepts, database design principles and Transaction management to describe DB to given scenario. CO3: Analyse the concepts of database management principles, Entity –Relationship model, ER to Relational mapping, relational algebra and database design principles. CO4: Design the given application without anomalies using ER modeling, Normalizations, transaction management properties. CO5: Synthesize sophisticated queries to extract the information from the given database using SQL and NoSQL. CO6: Develop and demonstrate Database Management System for real time problem in a deiverse team using appropriate tools. **19IS4PCADA - ANALYSISAND DESIGN OF ALGORITHMS** CO1: Apply various algorithmic design paradigms to basic computing problems. CO2: Analyze the time complexity of different algorithms. CO3: Design efficient algorithms using appropriate algorithm design techniques.

	CO4: Conduct experiments to implement algorithms and provide valid conclusions. CO5: Make effective presentations and documentation to justify the performance of designed algorithms for the computing problem. **19IS4PCJAV - JAVA PROGRAMMING** CO1: Comprehend the concepts of objects, classes, packages, interfaces, strings, collections and swing. CO2: Apply the principles of object oriented programming to solve problems. CO3Identify the usage of constructs for reusability, abstraction, exception handling and multithreading. CO4: Develop computer programs to handle runtime errors, concurrency, files, generics and graphical user interface components. CO5: Conduct experiments to implement various operations on classes and swing. CO6: Demonstrate coding skills on a competitive programming platform. **19IS4PCTFC - THEORETICAL FOUNDATIONS OF COMPUTATION** CO1: Understand the fundamental concepts of formal languages and automata. CO2: Apply basic algorithms to solve problems related to the area of theory of computation CO3: Recognise different computing language classes and their relationship. CO4: Analyse automata and their power to recognise languages. CO5: Design grammars and automata for different levels of formal languages. CO6: Construct and simulate automata using simulation tool. **19IS4PWUSP - UNIX SYSTEM PROGRAMMING** CO1: Apply API'sfor implementing UNIX commands, file management and process control

	CO2: Analyse System call interface for process management, multitasking programs, IPCS in UNIX CO3: Design client server communications using IPCS CO4: Communicate effectively in a team and demonstrate the solution for a given Problem.
Course Outcomes (COs) - **5th, 6th 7th & 8th Semester (Old Scheme)**	**16IS5DCJAV - PROGRAMMING WITH JAVA** CO1: Comprehend the concepts of object oriented programming, packages and applets. CO2: Apply the concepts of encapsulation, inheritance, polymorphism, packages, interfaces, generics, files and applets CO3: Analyze theusageofobject oriented programming concepts, exception handling and multithreading. CO4: Design computer programs to solve problems using object oriented concepts CO5: Conduct experiments using object oriented concepts to solve problems. CO6: Design and present solutions for applications using appropriate object oriented concepts. **16IS5DCDBM - DATABASE MANAGEMENT SYSTEMS** CO1: Comprehend the fundamentals of database management systems, ER model, relational algebra, SQL, design principles and Transaction management. CO2: Apply database management concepts, principles, Entity – Relationship model, relational algebra concepts, database design principles and Transaction management to describe DB to given scenario. CO3: Analyse the concepts of database management principles, Entity –Relationship model, ER to Relational mapping, relational algebra and databasedesign principles. CO4: Design the given application without anomalies using ER modeling, Normalizations, transaction management properties. CO5: Synthesize sophisticated queries to extract the information from the given database.

	CO6: Usage of modern tools to implement the real world applications (database)popular databases. CO7Communicate effectively as a member in a diverse team. **16IS5DCDCN - DATA COMMUNICATION AND NETWORKING** CO1: Acquire the Knowledge about the various principles of datacommunication in datalink layer and network layer CO2: Analyze the need of for different protocols in datalink layer and network layer of TCP/IP protocol suite CO3: Design network using internetworking concepts and related protocol by analysingthe need various routing protocols for different scenarios. CO4: Design wireless LAN, any network using internetworking concepts and protocols. CO5: Conduct simulation on a given network for global addressing, subnetting,routing and protocol usage. CO6: Conduct experiments on design of networking concepts using modern engineering tool. **16IS5DCWEP - WEB PROGRAMMING** CO1: Acquirethe basic knowledge of scripting language to build web pages CO2: Use XHTML concepts to provide interactive websites for client-server systems CO3: Validate user inputs based on constraints and requirements using javascript CO4: Identify appropriate web elements to prepare dynamic pages CO5: Interact with client-server systems on user specific mark-up language CO6: Conduct experimentsforthe real time concepts of web programming. **16IS5DEIOT - INTERNET OF THINGS** CO1: Familiarize with the fundamentals of Internet of Things for

	communication models. CO2: Apply the conceptsof sensors, cloud, data pushing and pulling mechanisms to develop IoT solutions. CO3: Explore appropriate architectures, programmable interfaces and communication technologies to design IoT models. CO4: Differentiate between the levels of the IoT stack, key technologies and protocols employed at each layer. CO5: Program a controlled software for the desired IoT applications using sensors, wireless network connections, display/actuators and data analytics. CO6: Create a working IoT prototype in teams involving design, programming and data analytics using appropriate hardware components and software tools. **16IS5DEDMG - DATA MINING** CO1: Comprehend the concepts of Data, Classification, Association and Cluster analysis. CO2: Apply the Concepts of pre-processing, classification and clustering for data extraction. CO3: Arrive at valid predictions by analysing proximity measures, OLAP and multidimensionality. CO4: Examine the association levels to generate rules for various item sets. CO5: Interpret the substantial conclusions obtained by using clustering and classification mining techniques. CO6: Conduct experiments using data mining techniques for Pre-processing, Association, Classification and Clustering using modern tools. **16IS5DEPYP - PYTHON PROGRAMMING** CO1: Understand the Python environment, basic operations, objects, files, exceptions, OOPs concepts, databases and System tools. CO2: Use operations and constructs of programming to implement solutions for engineering problems. CO3: Provide an analysis for usage of file operations, exception

	hierarchy and connectivity to database. CO4: Justify the importance of different programming constructs and system tools. CO5: Implement control structures using appropriate techniques and resources. CO6: Interpret various scenario based problems to provide feasible solutions. **16IS5DEAIN - ARTIFICIAL INTELLIGENCE** CO1: Understand the concept of agents, environments, search strategies, reasoning, logic and probabilities. CO2: Solve problems using uninformed and informed search strategies. CO3: Represent procedural and declarative knowledge by applying agent based rules. CO4: Providelogic based analysis for question and answering techniques. CO5: Formulateprobabilities for handling uncertain knowledge. CO6: Conductexperimentsrelated to artificial intelligence using PROLOG programming tool. **16IS6DCSEO - SOFTWARE ENGINEERING AND OBJECT ORIENTED DESIGN** CO1: Comprehend software life cycle, testing, UML notations and patterns. CO2: Apply appropriate associations, interaction modeling, predict patterns categories. CO3: Analyze software architecture, design models, testing methods and business solutions. CO4: Interpret requirements, test phases, modeling, transitions and architectural patterns. CO5: Design UML models, patterns, traceability matrix. CO6: Create models for a business solutions systems.

	16IS6DCCNS - COMPUTER NETWORKS AND SECURITY CO1: Understand the working principles of Transport, Application and Security protocols. CO2: Solve problems concerned with end to end communication and security by applying the concepts of various protocols. CO3: Review the functionalities of protocols at transport layer & application layer, security aspects. CO4: Interpret network and security algorithms with appropriate methods to provide valid conclusions. CO5: Formulate feasible solutions for practical applications using network simulators. CO6: Communicate effectively as a member in diverse team. **16IS6DCEAM - ENTREPRENEURSHIP AND MANAGEMENT** CO1: Obtain an understanding of entrepreneurial characteristics business ideas, organization structure, management and administration. CO2: Recognise opportunities byapplying ideas for product development, marketing and management. CO3: Review strategicplanning for entrepreneurialmanagement and legal forms of business. CO4: Develop businessplans based on product and services in-line with thetarget market. CO5: Provide analysis of organisation structures, business strategies, training and leadership models. CO6: Prepare documents and communicate effectively on entrepreneurial ventures and opportunities. **16IS6DCCDN - C# AND .NET** CO1: Comprehend .NET centric buildingblocks, syntactical constructs, concepts of OOP and Exception handling. CO2: Apply appropriate C# programming constructs, namespace ,Exception Handling and Object Oriented concepts to solve problems(L3)

	CO3: Identify value types, reference types, read only, System. Collections and Interfaces. CO4: Analyze C# programming constructs, nullable types, casting rules, Application level exception CO5: Conduct experiments as per the specific requirements and constraints usingintegrated developmenttools CO6: Create solutionsfor problems using appropriate constructs. **16IS6DCSNA - SOCIAL NETWORK ANALYSIS** CO1: Comprehend the basic knowledge of social network analysis, graphs, cliques, structural equivalence, positional analysis and data collection. CO2: Apply graphs and matrices torepresent social networks CO3: Analyze the usage of graphs, matrices and subgroups in social networks CO4: Communicate effectively in a team and investigate on the topics related to Social Network Analysis. **16IS6DECGS - COMPUTER GRAPHICS** CO1: Gain proficiency of computer graphics algorithms like modeling, transformations and rendering CO2: Perform simple 2D and 3D graphic transformations by applying graphics primitives. CO3: Recognize different techniques for analysing 2D, 3D and visible surface detection object geometry. CO4: Design algorithms for various graphics shapes including ellipse, hyperbola and triangle. CO5: Experiment various graphic primitives using OpenGL programming. CO6: Create effective OpenGL functions to solve graphics programming issues in 2D & 3D Object modeling. **16IS6DEVCS - VIRTUALIZATION AND CLOUD SECURITY** CO1: Understand computing systems, cloud-paradigms, security andprivacy issues in cloud environments.

	CO2: Apply the different computing principles using cloud environment. CO3: Analyse the importance of virtualization in distribute computing and how this has enabled the development of cloud computing. CO4: Design cloud environment for different real time requirements. CO5: Implement virtualization and cloud scenarios. CO6: Develop applications on cloud environments. **16IS6DEMLG - MACHINE LEARNING** CO1: Comprehend on machine learning algorithms based on concept learning, decision trees, neural networks, hypothesis and classifiers. CO2: Apply specific principles to obtain solutions for appropriate problems in learning tasks and instances. CO3: Identify the challenges to analyze different approaches for training intelligent systems. CO4: Evaluate hypothesis with suitable considerations for design of solutions to specific tasks. CO5: Investigate the strategies in well-posed and instance based problems to arrive at valid conclusions. CO6: Conduct experiments to demonstrate applicable techniques in machine learning. **16IS6DEPDC - PARALLEL AND DISTRIBUTED COMPUTATIONS THROUGH JAVA** CO1: Understand the basics of parallel and distributed computing environments. CO2: Design event listener interfaces and applets. CO3: Assess the concepts of issues and tasks in parallel and distributed computing, different parallel architectures, programming models and algorithms for common operations. CO4: Analyse connectivity and parallelism in database processing using files.

	CO5: Design parallel and distributed programming models for pipelined computations. CO6: Demonstrate parallel programming applications using CORBA. **16IS7DCMAD** **MOBILE APPLICATION DEVELOPMENT** CO1: Understand the components, controls, adapters, menus, packages, services and related functionalities of Android for mobile application development. CO2: Apply the knowledge of constructs in Java and XML to obtain feasible modules as a solution for engineering problems. CO3: Analyse packages, project libraries and services to obtain a framework for solving problems in development of mobile applications. CO4: Obtain the code patterns by investigating resources to arrive at valid conclusions. CO5: Create GUI programs based on common controls, themes, actions, components, handlers and mapping packages using Android Studio/SDK. CO6: Design mobile Apps to provide solutions for real world problems by incorporating multidisciplinary settings. **16IS7DCMCT** **MOBILE COMPUTING** CO1: Gain the knowledgeabout the fundamentals of Mobility Management,Computing Architecture, communications, Network Signalling, Services. CO2: Formulate the mobile communication services, signals, protocols by applying various technologies such as GSM, Wimax and GPRS. CO3: Analysethe strategies used in the implementation of mobile computing architecture. CO4: Demonstrate the properties of communication system components and processes by designing sample wireless networks. CO5: Ascertain the technological growth to interpret various types of mobile generation services.

	CO6: Simulate wireless communication network by using modern tools like Qualnet/Matlaband analyse the obtained results to arrive at substantial conclusions by communicating effectively as a member of diverse team. **16IS7DCICL - INDIAN CYBER LAW AND IT** CO1: Understand IT Act and itsAmendments, Cyber Law, Legal issues, Intellectual property rights and Certifying Authorities. CO2: Make use of IPR and its practices to commit towards social responsibilities. CO3: Identify various cybercrimes penalties and compensation with the knowledge of IT Act. CO4: Infer the impact of cybercrimes on society. CO5: Adapt UNCITRAL Model Law for lifelong learning. CO6: Communicate effectively and make effective presentation on recent cybercrimes cases. **161S7DEAWP - ADVANCED WEB PROGRAMMING** CO1: Paraphrase the basic structure and syntax of Ruby, Rails, Ajax and Jquery CO2: Apply the concepts of Ruby, Rails, Ajax and Jquery to add dynamicity and animations to web pages. CO3: Correlate the events and analyse the document modeling in establishing database connections through web pages. CO4: Integrate the interactive web applications using jQuery, Json, Ajax. CO5: Incorporate the information to provide valid conclusion on usage of various scripting frameworks. CO6: Demonstrate the implementation of scripting programs using modern web frameworks and tools. **16IS7DESAN - STORAGE AREA NETWORKS** CO1: Acquire the fundamental Knowledge of server centric, storage centric IT architecture, Intelligent disk subsystems, I/O techniques, NAS system and storage virtualization.

	CO2: Identify the need of different RAID levels, I/O techniques, Virtualization and management of storage networks. CO3: Apply the concepts of RAID, SAN, NAS, file systems in storage area networks. CO4: Determine the use of SNMP, CIM, WBEM and SMI-S by identifying its need in management of storage networks. CO5: Compare different RAID levels and analyze the benefits of virtualization in SAN. CO6: Extract information and make effective presentation and documentation on the benefits of the different network storage options for various application environments. **16IS7DECTS - CRYPTOGRAPHIC TECHNIQUES AND SECURITY** CO1: Comprehend the foundational theory of cryptographic techniques, principles and practices. CO2: Effectively apply various cryptographic techniques to solve security threats. CO3: Compare various cryptographic techniques that cause security risks in networks. CO4: Identify the elements of security protocols and methods to solve problems. CO5: Use appropriate public cryptosystem to evaluate information security risks. CO6: Develop security solutions of standard cryptographic algorithms using modern tools. **16IS7DEFDS** **FOUNDATIONS OF DATA SCIENCE** CO1: Acquire knowledge on data science using R tool, managing data, modeling methods, recommendation system and delivering the results. CO2: Apply machine learning concepts for data modeling, data evaluation and validation. CO3: Examine predictive data model analysis and the method for dimensionality reduction.

	CO4: Develop a model for content based systems and recommendation systems. CO5: Effective presentations, documentations and models are designed to end users. CO6: Demonstrate the data science process using modern tools. **16IS7DEACC - ADVANCED CLOUD COMPUTING** CO1: Comprehend the fundamentals of cloud computing technologies, role of networks, migration, distribution, security, web services. CO2: Apply the knowledge of cloud computing load distribution schemes, scheduling composite services, secure distribution of data for migrating applications to a cloud environment. CO3: Analysethe concepts of cloud computing such as vertical load distribution, scheduling composite services, secure distribution of data, various representation of data,open questions and challenges facing in current information technology. CO4: Design a cloud based applications by using the principles of cloud virtualization, cloud storage, security management, data management, load distribution for giving solutions to Information Technology services. CO5: Synthesize the data handling using XML parsers, JSON parsers, and REST services to investigate the status of remote object. CO6: Usemodern tools to implement the cloud application using popular cloud technologies. **16IS7DESTG - SOFTWARE TESTING** CO1: Understand the importance of software testing fundamentals and methodologies. CO2: Apply the knowledge of software testing strategies and methodologies for testing performance. CO3: Analyse various criteria's and specification for testing a software product. CO4: Design effective test cases to achieve requirement specification.

	CO5: Investigate various testing strategies to find bugs in the software. CO6: Demonstrate the usage of modern testing tools to write automation scripts. **16IS7IE1ML - MACHINE LEARNING** CO1: Comprehend on machine learning algorithms based on concept learning, decision trees, neural networks, hypothesis and classifiers. CO2: Apply specific principles to obtain solutions for appropriate problems in learning tasks and instances. CO3: Identify the challenges to analyse different approaches for training intelligent systems. CO4: Evaluate hypothesis with suitable considerations for designof solutions to specific tasks. CO5: Investigate the strategies in well-posed and instance based problems to arrive at valid conclusions. CO6: Predict probabilities for machine learning applications. **16IS7IE1IS - INFORMATION SECURITY** CO1: Obtain knowledge on the fundamentals of information security, risk management, firewalls and security management. CO2: Explore the various attacks, threats, access control, IDPS and risks. CO3: Protect remote connections, access risks, detect intrusions using security principles. CO4: Provide analysis for various risk controls, firewall detections and prevention systems. CO5: Use suitable security technologies and VPNs to protect data. CO6: Communicate effectively and make presentation on modern techniques for intrusion detection and prevention system of information security. **16IS7DCPRW - PROJECT WORK** CO1: Review the existing systems to formulate the problem.

	CO2: Select the modern tools for solving the identified engineering problem. CO3: Design a solution for the chosen problem. CO4: Analyze results of experiments conducted to arrive at valid conclusions and its impact on societal and environmental context. CO5: Communicate effectively through presentation and demonstration of the project and write effective Report. CO6: Function effectively in the team and contribute to the team. **16IS8DCPR - PROJECT WORK** CO1: Formulate the significant aspects perceived from literature survey which helps in problem analysis. CO2: Applying the Knowledge of problem analysis to identify the required design constraints to achieve solutions. CO3: Select the platform/tools in the set of alternatives identified for the project synopsis. CO4: Develop software to provide solution for the identified project. CO5: Investigating for arriving towards optimum valid results for implemented software project. CO6: Communicate effectively through presentation and demonstration of theproject and write effective report. CO7: Identify the community that shall benefit through the solution to the identified software problem and demonstrate concern for environment. CO8: Function effectively in the team, contribute to the team and mentor/lead the team. CO9: Demonstrate compliance to the prescribed standards/safety norms through implementation of the identified software problem. **16IS8DCGCT - GREEN COMPUTING** CO1: Create awareness about Green Software, Sustainable Software Development and Enterprise Green IT Strategy in the IT working environment leading to green computing. CO2: Apply the various methodologies to measure the sustainable

	performance of software projects. CO3: Analyse sustainability challenges associated with data centre and strategies to mitigate energy consumption. CO4: Analyse information requirements and methods utilized at multilevel sustainable information. CO5: Propose solutions for various case studies in Green Computing. CO6: Effective documentation and presentation of the technical paper with proposed sustainable solution for green computing. **16HS8DCSPF - SOFTWARE PROJECT MANAGEMENT AND FINANCE** CO1: Acquire knowledge on software project management facets,phases,knowledge areas,financial management and entrepreneurship CO2: Apply the project management knowledge areas associated with software managerial activities and requirements engineering CO3: Identify theories of financial management, quality management and entrepreneurship with related analysis CO4: Interpret cost estimation and budgets for the given case studies CO5: Recognize the impact of software project management principles on society through industry interaction CO6: Demonstration of projects in terms of software managerial activities and requirements engineering. **16HS8DELFE - LAW FOR ENGINEERS** CO1**:** Enumerate the principles of sustainable development. CO2: Discuss the significance of various legislations pertaining to engineers. **16IS8IE2WI - WEB PROGRAMING AND INTERNET APPLICATIONS** CO1: Understand the basic structure and syntax of Perl, Ajax, servlets and ASP.NET.

	CO2: Identify the knowledge of scripting language to add dynamicity to web pages. CO3: Formulate the various scripting languages in establishing data base connections through web pages. CO4: Analyse the client and server side web application using Perl, CGI scripting and Ajax. CO5: Compare and contrast various client/server side scripting frameworks. CO6: Demonstrate the implementation of web applications using modern web frameworks and tools. **16IS8IE2BD - BIG DATA ANALYTICS** CO1: Understand the concepts of data storage, Hadoop, HDFS, Map Reduce, YARN, Hadoop I/O and operations for analytics of big data. CO2: Apply the knowledge of data streaming, distributed file system, scheduling and cluster specification to obtain solutions for huge storage. CO3: Analyse the data storage problems and arrive at substantiated conclusions with Hadoop features and operations. CO4: Designstrategies for storage and analytics by investigating Hadoop benchmark & YARN configurations to arrive at valid conclusions. CO5: Createappropriate techniques using features and operations of Map Reduce & YARN for modeling data analytics. CO6: Designa framework to incorporate file based data structures for Hadoop/Yarn setup and installation to meet the storage requirements.
Name of the Programme	**M.Tech in Computer Network Engineering**
Programme Educational Objectives (PEOs)	PEO 1: Excel in their professional career in computer network engineering and allied disciplines PEO 2: Achieve Proficiency in Industry or Academia and Research & Development PEO 3: Exhibit professionalism, team work and adapt to the latest

	technologies through continuous learning
Programme Outcomes (POs)	PO1 An ability to independently carry out research /investigation and development work to solve practical problems P1A1 Conducting experiments to investigate/validate/analyse the identified research work (paper/Thesis); P1A2 Apply research methodologies/ techniques/modern tools to provide practical solution to benefit an identified community P1A3 Engage in critical analysis to arrive at a valid conclusion through research (theoretical/practical/ policy) to provide an alternate/optimal solution to an identified problem; P1A4 Ability to independently carry out study and present results (expected or otherwise) for a defined problem PO2 An ability to write and present a substantial technical report/document P2A1 Engage in independent study to prepare a Technical document/make an oral presentation to address engineering concepts P2A2 Engage in independent study to prepare a Poster presentation of the identified work/task; P2A3 Prepare a technical document for the identified product/ system; PO3 An ability to demonstrate mastery in the domain of the specialization of the program P3A1 domain; P3A2 To demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem that requires multiple skills P3A3 To demonstrate scholarship of knowledge to arrive at a mathematical model to effectively represent the given system/device P3A4 To demonstrate scholarship of knowledge through conducting experiments/ performing mathematical analysis/ simulation study to arrive at the operating range for various input parameters to ensure desired output/performance P3A5 P3A6 Comprehend management theories and practices to arrive at

	a business model for an engineering solution.
Course Outcomes (COs)	**<u>18ISCNBSMF - MATHEMATICAL FOUNDATIONS OF COMPUTER NETWORKS</u>** CO1: Apply the knowledge of probability theory, Random variables, Queuing models and graph theory's to solve real world problems. CO2: Analyze and Synthesize the inferences on real world engineering problems using Information, graph and queuing theories to realize network communication systems. CO3: Conduct experiments/simulations using computer programs to facilitate the analysis and representation of data from the chosen networking application domain. **<u>18ISCNPCCN - ADVANCES COMPUTER NETWORK</u>** CO1: Demonstrate in-depth knowledge in the area of Computer Networking. CO2: To demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem related to Computer Networks. CO3: Prepare a technical document for the identified Networking System. CO4: Conducting experiments to analyse the identified research work in building Computer Networks. **<u>18ISCNPCWN - WIRELESS ADHOC NETWORKS</u>** CO1: Enumerate the concept of wireless ad-hoc networks and issues in different layers of protocols in network. CO2: Articulate routing protocols of ad-hoc networks. CO3: Prioritize table-driven, on-demand and hybrid protocols and identify appropriate attributes for routing. CO4: Infer performance of various unicast and multicast routing protocols. CO5: Evaluate on security attacks and secure routing. CO6: Investigate the measurements of protocol performance in wireless ad-hoc networks.

	18ISCNPENS - CRYPTOGRAPHY AND NETWORK SECURITY CO1: Apply knowledge of classical encryption, decryption and key sharing technique to achieve secured data transmission between applications CO2: Demonstrate knowledge of various crypto systems and security protocols in attaining the secure communication. CO3: Prepare a technical document for the secured data transmission implemented between applications. **18ISCNPESR - SECURITY ASSESSMENT AND RISK ANALYSIS** CO1: Recommend contingency strategies for data backup, recovery, business resumption planning. CO2: Escalate process from incident to disaster in case of security disaster. CO3: Design a Disaster Recovery Plan for sustained organizational operations. CO4 Design a Business Continuity Plan for sustained organizational operations. **18ISCNPESC - SECURE CODING** CO1: Apply the principles of secure coding in practice. CO2: Evaluate the core Python programming to secure the code. CO3: Develop and deploy secured web applications. CO4: Create secured network programs. CO5: Design and develop secured code using modern tools. **18ISCNPENP - NETWORK PROGRAMMING** CO1: Apply the Client and Server design practices towards designing efficient Servers and Clients. CO2: Demonstrate the programming knowledge in designing and developing service specific Server with Clients. CO3: Perform independently/team to carry out study and Develop a Web Client and Server software for providing specified service using appropriate tools.

	CO4: Prepare a technical document for the Client-Server software developed. **<u>18ISCNPESD - SOFTWARE DEFINED NETWORK</u>** CO1: Conceptualize on data and controlplane separation, Openflow, network programmability, virtualization, data center constructs and SDN Framework. CO2: Apply plane-models, protocols, programmatic interfaces and framework notion for engineering deployments. CO3: Analyze paradigm shift in the functionality of network models, controllers and constructs. CO4: Assess the strategies used for development of software defined operations and infrastructure. CO5: Possess knowledge on industry-scale operations for network virtualization, data center design and modern orchestration. CO6: Ascertain practical implementation of SDN and learn controller application programs. **<u>18ISCNPEDS - ADVANCES DATA STRUCTURES</u>** CO1: Analyse and develop operations on linear and non-linear data structures. CO2: Design solutions for applications using appropriate data structures for efficient management of data. CO3: Carry out independent investigations of operations on various advanced data structures through experiments. **<u>18ISCNPESN - SOCIAL NETWORK ANALYSIS</u>** CO1: Mastery the notations and terminologies of social network. CO2: Visualize, Measure and Compare social network problems. CO3: Analyse data connectivity problems by using social network algorithms. CO4: Analyse multimedia connectivity problems by using social network algorithms. CO5: Apply algorithms on a real world social media problems.

	18ISCNPESA - ADVANCES STORAGE AREA NETWORK CO1: Demonstrate In-depth knowledge/Scholarship of knowledge in the area of storage area networks. CO2: Engage in independent study to prepare an oral presentation to address latest topics on storage networks. CO3: Prepare a technical document for the solutions for the storage area networks related proposed system. CO4: Engage in critical analysis to arrive at a valid conclusion through theoretical approach to provide an alternate solution to an identified problem in the area of storage area networks. CO5: Demonstrate In-depth knowledge/Scholarship of knowledge in. **18ISCNPEPR - PROTOCOL ENGINEERING** CO1: Compare the communication protocol development methods. CO2: Apply protocol specification languages for the given problems. CO3: Validate and verify using methods. CO4: Perform protocol verification and validation testing. CO5: Implement tools for protocol engineering. **18ALLPICRM - RESEARCH METHODOLOGY AND IPR** CO1: Ability to write and present a substantial technical report/document. CO2: Able to demonstrate a degree of mastery over the area of specialization. **18ISCNPCCL - CYBER SECURITY AND LAW** CO1: Discriminate and analyze problems involved in cybercrime CO2: Synthesis cybercrime issues on wireless and mobile devices CO3: Use and apply modern cyber forensics tools CO4: Analyze the computer forensic problems for a feasible solution CO5: Apply cyber law for a given type of cyber issues

	18ISCNPCIT - INTERNET OF THINGS CO1: Apply in-depth knowledge of Internet of Things in Identifying the appropriate APIs and Enabling Technologies required to develop applications of IoT. CO2: Apply Modern tools and techniques to provide solution to benefit an identified community. CO3: Apply Modern tools and techniques to provide solution to benefit an identified community. CO4: Analyse the data obtained from sensors to make it meaningful information. CO5: Prepare a technical document on the IoT solution model developed. **18ISCNPCNM - NETWORK MANAGEMENT** CO1: Enumerate the applications of NM and challenges pertaining to security management of an IT Manager. CO2: Articulate network management standards, models and language. CO3: Prioritizing network management functional groupings. CO4: Infer the performance of RMON groups and functions. CO5 Evaluate on event correlation techniques, TLV formats and parameters of SNMP model. CO6: Learn the network management models using ASN.1 notation and latest RFCs update. **18ISCNPEHP - HIGH PERFORMANCE COMMUNICATION NETWORKS** CO1: Demonstrate In-depth knowledge In high speed networks and estimate the link performance. CO2: Communicate and present effectively the principles used in High Performance computing. CO3: Engage in critical analysis to arrive at a valid conclusion for novel ideas in the area of High Speed Networking via research Publications.

	CO4: Engage in independent study to prepare a Technical document to address High Speed Networks concepts. **18ISCNPEAA - ADVANCED ALGORITHMS** CO1: Determine the asymptotic complexity of iterative and recursive algorithms. CO2: Design and implement efficient solutions to various real world problems through algorithms. CO3: Evaluate and justify algorithmic solutions for their correctness and complexity. CO4: Carry out independent investigations of algorithm solutions for a defined computational problem through experiments. **18ISCNPEML - ADVANCED MACHINE LEARNING** CO1: Explore machine learning algorithms based on concept learning, decision trees, neural networks, hypothesis and classifiers. CO2: Formulate solutions for appropriate problems in learning tasks using principles and instances. CO3: Analyse classification and stochastic approaches for training intelligent systems. CO4: Estimate hypothesis and dimensions with suitable considerations for design of solutions to specific tasks. CO5: Investigate the strategies in well-posed and instance-based problems to arrive at valid conclusions. CO6: Conduct experiments to demonstrate applicable techniques in machine learning. **18ISCNPEBD - BIG DATA ANALYTICS** CO1: Analyze big data, data science and its applications. CO2: Analyze NoSQL data models and compare with RDBMS. CO3: Identify and analyze design issues of Hadoop and HDFS. CO4: Use MongoDB and MapReduce to perform data analytics and

	for data visualization. **<u>18ISCNPECC - CLOUD COMPUTING</u>** CO1: Apply depth knowledge of Cloud computing theories and practices for building and managing Cloud. CO2: Engage in critical analysis to arrive at a valid conclusion through research to provide an alternate/optimal solution to an identified problem. CO3: Demonstrate in-depth knowledge of Cloud computing to build a private Cloud. **<u>18ISCNPEMD - MOBILE APPLICATION DEVELOPMENT</u>** CO1: Gain insight on components, controls and functionalities of Android for application development. CO2: Conceptualize on Android constructs to obtain feasible modules as a solution for engineering problems. CO3: Analyse packages, project libraries and services to obtain a framework for solving problems in development of mobile applications. CO4: Obtain the code patterns by investigating resources to arrive at valid conclusions using debugging tools. CO5: Illustrate programming resolutions for applications by incorporating appropriate settings. **<u>18ISCNOECN - COMPUTER NETWORK</u>** CO1: Apply the knowledge of networking architectures and technologies in designing/building a computer network and evaluating its performance. CO2: Demonstrate various protocols, global addressing, Subnetting, VLAN, forwarding and routing in Internetworking. CO3: Design various Internetworking applications (e.g. Client Server applications, Web Services). CO4: Perform in a team to implement network applications using networking tool. **<u>18ISCNIEWT - WEB TECHNOLOGIES</u>**

	CO 1: Apply HTML, CSS and Javascript to design and build webpages. CO 2: Use core web coding languages to add dynamic content, animation and effects to websites. CO 3: Design and Build interactive web apps using data-driven technologies using modern Integrated Development Environments. CO 4: Prepare a technical document for the web application solution. **18ISCNPEBM - BUSINESS MODELS AND ENTREPRENEURSHIP** CO1: Demonstrate knowledge of management methods. CO2: Ability to experiment the strategy. CO3: Ability to frame an innovative accountability. CO4: Ability to pivot, accelerate and grow the startup's. **18ISCNPEEB - E-BUSINESS** CO1: Demonstrate knowledge of digital business and e-commerce. CO2: Ability to develop digital business infrastructure. CO3: Demonstrate digital business strategies. CO4: Implementation of digital business and optimization. **18ISCNPEBA - BUSINESS ANALYTICS** CO1: Apply the knowledge of data analytics. CO2: Mastery in data visualization tools to make effective analytics. CO3: Demonstrate the ability to statistical methods on business data. CO4: Mastery the utilization of different kind of regression models on business data. CO5: Apply data mining techniques to extract the hidden data. **18ISCNPEKM - KNOWLEDGE MANAGEMENT** CO1: Demonstrate knowledge of Strategic knowledge management process.

	CO2: Demonstrate the knowledge management culture. CO3: Ability to build knowledge infrastructure. CO4: Ability to develop an effective knowledge service.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

Academic Year 2019-20

Name of the Programme	B.E. in Electronics & Instrumentation Engineering
Programme Specific Outcomes (PSOs)	1. Ability to apply the concepts of data acquisition, signal conditioning, control and communication in the field of electronics and instrumentation. 2. Ability to simulate , analyse and interpret Analog/Digital circuit designs related to applications of Automation and control using modern engineering tools. 3. Ability to apply the knowledge of PLC, SCADA and DCS with industrial networking protocols for process industries.
Programme Outcomes (POs) PO1 to PO12	PO1: **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2: **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. PO5: **Modern Tool Usage :**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. PO6: **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. PO7: **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development. PO8: **Ethics :**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9: **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11: **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one"s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12: **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Course Code	Course Title	Course Outcomes
		III Semester
19MA3BSEM3	Engineering Mathematics - 3	CO1: Apply Numerical techniques to solve problems arising in engineering CO2: Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms.

		CO3: Apply the concepts of calculus to functionals.
19ES3CCECA	Electrical Circuit Analysis	CO1: Ability to define, understand and explain concepts related to electrical circuits CO2: Ability to apply the knowledge of network theorems to the given electrical circuit to obtain the desired parameter CO3: Ability to analyze given electrical circuit to arrive at a suitable conclusion CO4: Ability to conduct experiments to demonstrate the specified concept/ application of electrical circuit on the Multisim Platform CO5: Ability to analyse the given electrical circuit on the Multisim platform to compute the desired parameter
19ES3CCAEC	Analog Electronic Circuits	CO1: Ability to define ,understand and explain concepts related to diodes and transistors (BJTs and MOSFETs) CO2: Ability to apply the knowledge of network theorems to the given analog electronic circuit to obtain the desired parameter CO3: Ability to analyze given analog electronic circuit to arrive at a suitable conclusion CO4: Ability to design analog electronic circuit for given application and specifications CO5: Ability to design and conduct experiment using analog electronic circuit for given application and specifications CO6: Ability to conduct experiments to verify THREE parameters of the datasheet of the given electronic component
19ES3GCSAM	Sensors and Measurements	CO1: Ability to understand, define and explain the concepts of Sensors and Measurements. CO2: Application of science and engineering fundamentals to realize sensor based measurement systems. CO3: Analyze engineering problems and performance characteristics in order to arrive at suitable techniques for measurements. CO4: Providing solutions to specific measurements needs. CO5: Ability to conduct experiments to verify few parameters from the datasheet of the given sensor.
19ES3CCDEC	Digital Electronic Circuits	CO1: Ability to understand, define and explain the fundamental concepts of Digital Electronic circuits CO2: Ability to apply the concepts and simplification methods of Digital Electronic circuits for the specified application CO3: Ability to analyse digital electronic circuit and arrive at suitable conclusions CO4: Ability to design a digital circuit to meet given Specifications CO5: Ability to conduct experiments to demonstrate the specific application of digital electronics using suitable digital ICs/Multisim.

19EI3PCLOI	Laser and Optical Instrumentation	CO1: To understand the basic fundamentals of Laser and optical fiber Instrumentation. CO2: To apply the basic science fundamentals in understanding the principles, characteristics and construction of various types of Lasers and Optical fibres. CO3: To apply and analyze the basic engineering principles in understanding the basic instrumentation principle using different type of Laser and optical fibres. CO4: To comprehend the working of optical fibre sensors and detectors for measurement of various parameters. CO5: Usability of the laser and optical fiber sensors to solve the societal problems.
19IC3HSCPH	Constitution of India, Professional Ethics and Human Rights	CO1: Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land. CO2: Analyse the concepts and ideas of Human Rights. CO3: Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
IV Semester		
19MA4BSEM4	Engineering Mathematics -4	CO1: Demonstrate an understanding of concepts of statistical analysis and probability distributions. CO2: Apply Numerical techniques to solve partial differential equations arising in engineering. CO3: Demonstrate an understanding of analytic functions and their application to evaluate integrals.
19ES4ESCST	Control Systems	CO1: Define, understand and explain concepts related to linear control systems CO2: Apply the knowledge of engineering fundamentals to form mathematical model and derive transfer function of a system CO3: Analyse, Investigate the stability and/or design a LTI system in time/ frequency domain. CO4: Obtain the state space model of a system CO5: Analyse the behaviour of a given LTI system using modern simulation tool and communicate effectively with presentations/reports.
19ES4CCLIC	Linear Integrated Circuits	CO1: Ability to define ,understand and explain concepts of linear integrated circuits (LIC) CO2: Ability to apply the concepts of LIC to obtain the desired parameter CO3: Ability to analyze given LIC to arrive at a suitable conclusion CO4: Ability to design LIC for given application and specifications CO5: Ability to conduct experiments to demonstrate the specified concept/ application of LIC CO6: Ability to conduct experiments to verify THREE parameters

		of the datasheet of the given LIC/Component
19ES4CCMCS	Microcontrollers	CO1: Ability to understand and explain architecture of microprocessors and microcontrollers, pipelining, addressing modes, data types in Embedded C, serial communication, timer configuration and interrupt handling of microcontroller, memory expansion, control signal and wait states. CO2: Ability to calculate instruction execution time, delay, baud rate, and develop assembly and C Code, identify the timer mode, serial communication mode and interrupt priorities. CO3: Ability to design an 8051 system by interfacing 8051 to external memory , I/O, peripheral devices and external devices. CO4: Ability to analyse the code in assembly as well as Embedded C. CO5: Ability to conduct experiments by simulating, interfacing, debugging and executing the assembly and Embedded C code .
19ES4CCSAS	Signals and Systems	CO1: Apply the knowledge of mathematics to obtain desired parameters of a given signal/system. CO2: Analyze the given system in time domain and frequency domain to arrive at a valid conclusion. CO3: Design a system to meet desired specifications CO4: Ability to engage in independent study to make an effective presentation and submit reports on applications of signal processing concepts in various domains.
19EI4PCEMF	Electro Magnetic Field Theory	CO1: Ability to define, understand, and explain concepts on Electrostatics and magnetostatics, Time varying fields and Maxwell's equations, EMI and EMC. CO2: Ability to apply various properties/ laws/theorems/ Maxwell's equations of electrostatics, magnetostatics to solve/derive examples in different media of time varying fields. CO3: Ability to analyse the given specifications of static and time varying Electric, Magnetic field. CO4: Ability to make an effective oral presentation on Electromagnetic transmission norms, radiation hazards, effect on Environment, EMI and EMC.
19IC4HSEVS	Environmental Studies	CO1: Understand the components and impacts of human activities on environment. CO2: Apply the environmental concepts for conservation and protection of natural resources. CO3: Identify and establish relationship between social, economical and ethical values from environmental perspectives.

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DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

5TH Semester	
PROCESS CONTROL-16EI5DCPCS	
CO 1:-	CO1: Ability to define, Understand the basic principles, use of block diagrams & design of process control systems also to understand the importance of process control in industrial process plants and apply engineering knowledge to do problem analysis in process control.
CO 2:-	**CO2:**Ability to **Apply the knowledge** of process control , P&ID (Process & Instrumentation Diagrams) & devise simple but effective plant wide control strategies using appropriate heuristics.
CO 3:-	**CO3 :**Ability to **analyze** controllers by Selecting the proper discontinuous/ continuous controllers for a particular application related to process control.
CO 4:-	**CO4:**Ability to **Design, interpret and implement** tuning of the controllers using various methods and study about digital controllers and data loggers.
CO 5:-	**CO5:**Ability to **conduct experiments** to demonstrate concepts related to process control using suitable electronic components and Engineering Tools.
CO 6:-	**CO6 :**Ability to **engage in self –study to formulate, design, implement, analyse and demonstrate an application** using process control components through mini projects which leads to **team work** addressing the safety and environmental aspects , and which also focuses on societal and environmental friendly projects.
SENSORS AND TRANSDUCERS-16EI5DCSET	
CO 1:-	**CO1:** Understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of transducer /sensors.
CO 2:-	**CO2:** Understand fundamentals of fluid flow and their applications to flow through pipes and hydraulic machines.
CO 3:-	**CO3:** Understand various techniques used for measuring parameters of temperature measurement in Industries.
CO 4:-	**CO4:** Understand the principles of industrial processes & process in pressure measurement
CO 5:-	**CO5:** Understand the different types of force & level measurements adopted in industrial
CO 6:-	**CO6:** Understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of transducer /sensors.
DIGITAL SIGNAL PROCESSING-16EI5DCDSP	
CO 1:-	**CO1:** To apply knowledge of Mathematics and Engineering to understand Sampling and Reconstruction of signals from the given samples.
CO 2:-	**CO2:** An ability to identify and analyze a problem and formulate the computing requirements to determine the DFT of the given signals.
CO 3:-	**CO3:** An ability to implement the processes of FFT to reduce the computational

	complexity and to increase the speed.
CO 4:-	**CO4:** An ability to understand and formulate algorithms using the Multirate signal processing for sampling rate conversion in speech signal analysis.
CO 5:-	**CO5:** An ability to use current techniques and modern tools to improve the Medical data analysis**.**
ELECTRO MAGNETIC FIELD THEORY-16EI5DCMFT	
CO 1:-	**CO1: Ability to define, understand, and explain** concepts on electrostatics and magneto statics, Time varying fields and Maxwell's equations, Electromagnetic compatibility and Electromagnetic interference.
CO 2:-	**CO2: Ability to apply** various properties/ laws/theorems/ Maxwell's equations of electrostatics, magneto statics to solve/derive examples in different media of time varying fields.
CO 3:-	**CO3**:**Ability to analyze** the given specifications of static and time varying Electric, Magnetic fields in various configurations/ distributions
CO 4:-	**CO4: Ability to make an effective oral presentation / report writing** on Electromagnetic fields , radiation hazards, effect on environment, EMI and EMC concepts.
COMMUNICATION SYSTEMS-16EI5DCCST	
CO 1:-	**CO1:**To define, understand and explain the concept of modulation, demodulation, figure of merit ,sampling, quantization, multiplexing
CO 2:-	**CO2:** To apply the knowledge of basic systems to articulate the building blocks of the given analog/digital communication system and derive figure of merit for the system.
CO 3:-	**CO3:** To analyze interaction among various blocks of a given analog/digital communication system to obtain waveform at different points for given specifications and obtain noise performance parameters.
CO 4:-	**CO4:** To design and decide the modulators, demodulators, sampling rate, type of encoding for given specifications of analog/digital communication system
CO 5:-	**CO5:** To simulate the modulator-demodulator for the given analog/digital communication system using modern tools
LASER AND OPTICAL FIBER INSTRUMENTATION-16EI5DE1OI	
CO 1:-	To **apply** the basic science fundamentals in understanding the principles, characteristics and construction of various types of Lasers and Optical fibres
CO 2:-	To **apply a**nd **analyze** the basic engineering principles in understanding the basic instrumentation principle using different type of Laser and optical fibres

CO 3:-	To **comprehend** the use of optical fibre sensors and detectors for measurement of various Analytical parameters
CO 4:-	Ability to engage in **effective written and Oral communication** through the report/poster by taking a case study/ literature paper review/ICT videos in the Industrial applications of optical fiber sensors or lasers.
POWER ELECTRONICS-16EI5DE1PE	
CO 1:-	**CO1:**Identify the need for efficient conversion and control of electrical energy to match the load requirements
CO 2:-	**CO2:** Comprehend the characteristics of practically available Power Electronics devices.
CO 3:-	**CO3:** Analyze different types of converters such as AC to DC, DC to AC, DC to DC and comprehend their steady state behavior.
OOPS USING C++ 16EI5DE1CP	
CO 1:-	**CO1:** To differentiate between Procedure Oriented and Object Oriented Programming, benefits, understand the fundamental concepts, develop programming skills.
CO 2:-	**CO2:** To develop programs using OOP concepts to provide solutions to an engineering problem.
CO 3:-	**CO3:** To understand and explain the benefits of operator overloading, inheritance and pointers in program development.
CO 4:-	**CO4:** To explain the use of templates, stream and stream classes to implement input-output operations.
CO 5:-	**CO5:** To understand and discuss storing, retrieving data from files, file and exception handling.
FUNDAMENTALS OF HDL - 16EI5DE1HD	
CO 1:-	**CO1:** To learn the role of HDL in digital system design using latest tools like VHDL and Verilog.
CO 2:-	**CO2:** To Describe and test digital logic circuits in data flow description, structural description, behavioral description and advanced constructs (procedures, tasks, functions) using both VHDL and Verilog.
CO 3:-	**CO3:** To Apply the overall knowledge of digital circuit design using HDL for gate level synthesis targeted for FPGA /CPLD as preparation for project work.

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DATA ACQUISITION AND VIRTUAL INSTRUMENTATION-16EI6DCDVI	
CO 1:-	**CO1:** Ability to **Apply**, **Analyze and Comprehend** the structured programming concepts in developing VI programs and employ various debugging techniques.
CO 2:-	**CO2:** Ability to **Identify** and comprehend various built in analysis functions and communication protocols to process the data.
CO 3:-	**CO3:** Ability to **identify Elements** of Data acquisition for Software and hardware installation and **Create** applications that uses plug in DAQ boards
CO 4:-	**CO4:**.Ability to **design**, Create **and Simulate** various virtual Instrument applications.
CO 5:-	**CO5:** Ability to **develop** programs/**conduct** experiments using the basic elements like control statements, Arrays, clusters, Strings and File I/O functions
CO 6:-	**CO6:** Ability to engage in independent learning, submit a report/poster in **designing, implementing, analyzing** and **demonstrating** an application using tools in available in LabVIEW through an open ended experiment.
ALGORITHMS AND SYSTEM DESIGN-16EI6DCASD	
CO 1:-	Recognize and apply the fundamentals of fixed and floating point architectures of various DSPs
CO 2:-	Learn the architecture details , instruction set of floating point DSP and analyze their requirements in bringing out real time solutions
CO 3:-	Infer about the control instructions, interrupts, and pipeline operations.
CO 4:-	Illustrate the features of on-chip peripherals and its interfacing along with programming details.
CO 5:-	Learn the DSP programming tools and apply them for real time problems and present the solutions in a team as self-study component
CO 6:-	Analyze and learn to implement the signal processing algorithms in DSPs to design systems
CO 7:-	Design and implement signal processing modules using DSP processor and peripherals
SIGNALING AND COMMUNICATION IN PROCESS AUTOMATION-16EI6DCSAC	
CO 1:-	**CO1: Ability to Define, understand and explain concepts of** network on the basis of various network parameters and protocols and to give overview of OSI-ISO and TCP/IP network models in industrial data communication systems.
CO 2:-	**CO2:** Ability to **apply** the knowledge of inter-networking and to provide fundamental understanding of common principles, various standards and protocols.
CO 3:-	**CO3: Ability to analyze the** architecture and the protocols HART, field bus and profibus of industrial data networks and they can apply the knowledge acquired in industrial automation.

CO 4:-	**CO4: Ability to design and** develop an understanding of and be able to select and use most appropriate technologies and standards for a given application using Industrial ETHERNET and wireless communication.
CO 5:-	**CO5: Ability to make an effective written / oral presentation/report/ poster design with presentation** individually or as team on standards, protocols, case studies ,literature paper ,industrial automation, contribution to society, impact on health, effect on environment.
ANALYTICAL INSTRUMENTATION-16EI6DCANI	
CO 1:-	To Acquire knowledge about the interaction of electromagnetic radiations with matter and **apply** analytical techniques to accurately determine the elements present in the given sample and various phenomenon related to it.
CO 2:-	To **apply and analyze** the basic engineering principles in understanding the basic instrumentation principle behind various spectroscopic methods.
CO 3:-	**identify** and comprehend the working of various transducers in various spectroscopic methods
CO 4:-	Ability to investigations and analysis of different samples using different analytical instruments
DIGITAL IMAGE PROCESSING -16EI6DE2DP	
CO 1:-	Ability to define, explain and understand pixels, enhancement, restoration, segmentation, thresholding , identify steps ,components of Image processing system, relation between pixels
CO 2:-	**CO2:** Ability to **d**iscuss algorithms used for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding.
CO 3:-	**CO3:** Ability to **d**iscuss performance of algorithms for image enhancement in spatial and frequency domain, restoration, segmentation, thresholding
CO 4:-	**CO4:** Ability to design and implement masks, algorithms for the given image processing application
CO 5:-	**CO5:**Ability to simulate the algorithms used in image processing using modern tools
CONTROL SYSTEM COMPONENTS-16EI6DE2CC	
CO 1:-	**Co1:** identify and utilize the various components used in the process control Loops
CO 2:-	**Co2:** understand the fundamental principles of working of various Components used in Process loops
CO 3:-	**Co3:**design profiles for gears and cams based on control application
CO 4:-	**Co4:** differentiate between various components application, its usage, Advantages and disadvantages

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DIGITAL SYSTEM DESIGN USING VHDL-16EI6DE2DD	
CO 1:-	**CO1:** Use of advanced programming concepts of VHDL and develop VHDL code to model and simulate basic combinational networks and sequential machines.
CO 2:-	**CO2:** Design combinational networks and sequential machines for PLA, PAL, FPGAs and CPLD variants using SM chart based representation.
CO 3:-	**CO3:** Design of functional blocks for arithmetic operations (adders, multipliers and dividers) using the knowledge of combinational networks and sequential machines.
CO 4:-	**CO4:** Develop VHDL models for functional representation of memory element, memory interfaces, communication bus and floating point operations.
CO 5:-	**CO5:** Use of advanced programming concepts of VHDL and develop VHDL code to model and simulate basic combinational networks and sequential machines.
BIOMEDICAL INSTRUMENTATION-16EI6DE2BM	
CO 1:-	CO1: Discuss basic performance requirements of medical instruments.
CO 2:-	CO2: Describe the various Bio-Signal acquisition systems and relate to physiological Parameters
CO 3:-	CO3: Discuss the techniques for blood pressure measurement.
CO 4:-	CO4: Understand types of pace makers and defibrillators.
CO 5:-	CO5: Understand safety measures in a medical instrument design and signal transmission in bio telemetry
OPERATING SYSTEM-16EI6DE2OS	
CO 1:-	**CO1:** understand types of OS, fundamental concepts, techniques used in the execution of programs.
CO 2:-	**CO2:** understand and explain the different techniques being employed in scheduling and memory allocation.
CO 3:-	**CO3:** understand and discuss page replacement policies and the way computers stores files on disk
CO 4:-	**CO4:** explain message passing, deadlock detection, resolution and prevention.
CO 5:-	**CO5:** understand and discuss the protection system for computer system resources.
Fundamentals of VLSI-16EI7DCFVI	
CO 1:-	**CO1:** Describe the fabrication process and analyze the basic electrical properties of MOS circuits**.**
CO 2:-	**CO2:** Analyze the CMOS layout levels, how the design layers are used in the process sequence, and resulting device structures (i.e. cross-sectional views).
CO 3:-	**CO3:** Discuss the different types of inverters also Design and implement CMOS circuits in silicon also to Implement digital logic designs of various types (i.e. combinational logic, multiplexers).
CO 4:-	**CO4:** Illustrate circuit diagrams, stick diagrams and layouts for nMOS, CMOS and BiCMOS circuits. Explain design rules. Compare different technologies.
CO 5:-	**CO5:** Analyze and design subsystems using structured approach for MOS technologies and implementation of computational elements memories & register circuits.

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AUTOMATION IN PROCESS CONTROL-16EI7DCAPC	
CO 1:-	**CO1:**Able to gain knowledge about the working of Data Loggers, DDC, SCADA, DCS, PLC and its uses in solving engineering problems.
CO 2:-	**CO2:** Able to apply the concepts of automation for various processes.
CO 3:-	**CO3:**Able to analyze and formulate the requirements of appropriate ladder programs to provide solutions using PLCs.
CO 4:-	**CO4:** Able to design and apply program control, arithmetic, relay, data handling, sequencer, timer and counter instructions in development of solutions
CO 5:-	**CO5:** Able to select, design, apply, simulate and experiment appropriate techniques to develop solutions for practical applications using modern tools.
CO 6:-	**CO6:** Ability to pursue self-study to formulate, design, and select appropriate programming techniques using PLC to automate a given process.
CO 7:-	**CO7:** Ability to communicate with effective presentations and submit reports
Modern Control Theory-16EI7DCMCT	
CO 1:-	**CO1:** Ability to identify, categorize different types of non linearities and analyze the behavior of nonlinear system using describing functions.
CO 2:-	**CO2:** Able to represent and analyze given continuous and discrete time systems in the state space form.
CO 3:-	**CO3:** Ability to design and analyze the cascade compensators to meet the required specifications using bode plot and root locus techniques.
INDUSTRIAL INSTRUMENTATION-16EI7DE3II	
CO 1:-	**CO1:**Study of Instrumentation and Control Systems used in various power plants
CO 2:-	**CO2:**Understand various standards and protocols used in different power plants
CO 3:-	**CO3:**Discuss state of art technologies used in power sector
CO 4:-	**CO4:** An ability to select and use latest technology tools for various processes and systems.
CO 5:-	**CO5:** Ability to understand of contemporary / emerging technology for various processes and systems.
Aircraft instrumentation-16EI7DE3AI	
CO 1:-	**CO1: :** Ability to **define, Understand** qualitative and quantitative display as per the basic T grouping and by giving importance to the aesthetics view of the front panel of an aircraft.
CO 2:-	**CO2:** Ability to **Apply the knowledge** of aircraft instrumentation concepts and analyze the complexity and high functionality of air data instruments.
CO 3:-	**CO3:** Ability to **analyze and Design** a match warning system, Altitude alerts systems, Airspeed warning systems.
CO 4:-	**CO4:** Ability to **Describe and understand** the operation of flight instruments incorporating gyroscopes, basic flight indicators, sensors and its operating principles and types of displays.
CO 5:-	**CO5:** Ability to engage in **effective written and Oral communication** through the report/poster by taking a case study/ literature paper review/ videos in aircraft instrumentation.

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DEPARTMENT OF ELECTRONICS & INSTRUMENTATION ENGINEERING

REMOTE SENSING&TELEMETRY-16EI7DE3RT	
CO 1:-	**CO1:** Understand the basic of telemetry system.
CO 2:-	**CO2:** Discuss the principles of remote sensing and its applications.
CO 3:-	**CO3:**Analyse the various processing done for proper interpretation
COMPUTER VISION-16EI7GE2CV	
CO 1:-	**CO1:** Understand the principles general practices followed in image mation
CO 2:-	**CO2:**Analysis and selection of techniques of Feature extraction applied to images
CO 3:-	**CO3:**Classification of images using Parametric and non-parametric methods
CO 4:-	**CO4:** Analyze and build prototypes of the motion dynamics using the modeling techniques
CO 5:-	**CO5:** Apply the image processing techniques for computational photography
MEMS and Sensors-16EI7GE2MS	
CO 1:-	**CO1:** To **Analyze** the theories and concepts of micro electro mechanical systems.
CO 2:-	**CO2:** To **comprehend** the basic principles, working and **identify** type of materials used for various types of micro sensors and actuators.
CO 3:-	**CO3:** To **Illustrate** range of fabrication techniques used in microsystem design and **analytically** describe different deposition techniques and **identify** different effects occurring during depositions on various topographies.
CO 4:-	**CO4:** To **apply** the basic engineering principles in understanding the scaling effects in different physical principles related to microsystems.
CO 5:-	**CO5:**Able to **Comprehend** the state-of-the-art of micromachining and packaging technologies
CO 6:-	**CO6:** To **Engage** in Independent learning in analyzing and demonstrating an applications of MEMS devices through Case Studies/Literature review in the form of report/poster
Project for Community Service-16EI7DCPCS	
CO 1:-	CO1: Do a survey and formulate a problem identified.
CO 2:-	CO2: Apply a suitable engineering/IT tool for modeling/data interpretation/analysis, conduct experiments leading to a logical solution of the proposed problem.
CO 3:-	CO3: Compare the proposed solution with other available alternatives.
CO 4:-	CO4: Communicate effectively to a diverse audience trough presentations and develop technical reports and publications
Automotive Instrumentation- 16EI7IE2AU	
CO 1:-	**CO1:** Know the working OPS, ABS, ACC and TCS in gasoline and diesel engines
CO 2:-	**CO2:** Analyze the architecture and role of electronic components in a vehicle

CO 3:-	**CO3:** Determine the functions of control units and mechatronics in an automobile engineering
CO 4:-	**CO4:** Analyze the requirement of sensors and actuators for automobile applications
CO 5:-	**CO5:** Describe the working of various sensors used in automotive electronics
MICRO-SENSING NETWORKS FOR SUSTAINABLE CITIES-16EI8IEMNS	
CO 1:-	**CO1:** Understand the need for sustainable Engineering solutions for Environmental framework.
CO 2:-	**CO2:** Analyze the requirements of sustainable development for different Environmental context.
CO 3:-	**CO3:**Develop solution by applying social, economic, Environmental considerations
CO 4:-	**CO4:**Self-study on various cases and presentation of report and seminars
PROJECT MANAGEMENT AND FINANCE-16HS8DCPMF	
CO 1:-	**CO1:** Apply the Knowledge of project management principles and to implement project management methodologies required for successful project completion
CO 2:-	**CO2**: Develop Ethical principles in project planning and execution as a team and documentation in project implementation.
CO 3:-	**CO3:** Identify and Apply finance aspects for project implantation in time**.**
CO 4:-	**CO4:** Use modern tools to simulate their respective projects and case studies and investigate the behavior under various operating conditions.
Intellectual Property rights and cyber law-	
CO 1:-	Ability to apply ethical principle to obtain Intellectual property Rights like Patents, Copyright & Trademarks
CO 2:-	Understand the impact of Patents, Copyright & Trademarks and demonstrate the knowledge of Cyber Law for the sustainable development
CO 3:-	Apply concepts of IPR and Cyber Law to access societal, health, safety & Cultural issues and continue responsibilities relevant to the professional engineering practice
CO 4:-	Ability to work in multiple teams to effectively communicate IP & Cyber Law leading to improvement in team work and leadership qualities.
Major Project-16EI8DCMPJ	
CO 1:-	Demonstrate a sound technical knowledge of their selected project topic.
CO 2:-	Undertake problem identification, formulation and solution
CO 3:-	Design engineering solutions to complex problems utilising a systems approach.
CO 4:-	Conduct an investigation in engineering project
CO 5:-	Interpret data to provide valid conclusion.
CO 6:-	select appropriate techniques and simulate using modern tools
CO 7:-	apply reasoning relevant to engineering practice

CO 8:-	Understand impact of engineering solutions in societal and environmental context
CO 9:-	Demonstrate the knowledge, skills and attitudes of a professional Ethics and responsibilities applied relevant to engineering practice
CO 10:-	Effective functioning as individual and in a team
CO 11:-	Communicate with engineers and the community at large in written ,oral and social learning platforms
CO 12:-	Apply and use management principles for their work , team work and managing the dependencies between tasks .
CO 13:-	Exhibit ability to engage in life long learning in the perspective of technological requirements of the project
Seminar Based on Internship/Industrial Training-16EI8DCSMR	
CO 1:-	**CO1:** Analyze and interpret data for complex systems.
CO 2:-	**CO2:** Select and apply modern engineering tools
CO 3:-	**CO3:** Communicate Effectively to an Audience, and design documentation (written graphical and visual forms)
CO 4:-	**CO4:** Engage in independent learning
Operations Research-16EI8IE2OR	
CO 1:-	CO1 To be able to understand the fundamental concept and approach of linear programming appropriate to the further study of operations research and identify problems in real life
CO 2:-	CO2 To be able to recognize and optimize the transportation and assignment problems
CO 3:-	CO3 To be able to recognize and solve Queuing theory problems
CO 4:-	CO4 To be able to use network planning procedures for solving logistics problems
CO 5:-	CO5 To be able to recognize and solve Game theory problems

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DEPARTMENT OF MEDICAL ELECTRONICS

Academic Year 2019-20

Name of the Programme	B.E. in Medical Electronics
Programme Specific Outcomes (PSOs)	1. PSO1: Investigate, Implement and demonstrate various applications of analog and digital electronic subsystems in designing and building biomedical instrumentation systems. 2. PSO2: Specify, architect and prototype health-care solutions by applying signal and medical image processing techniques on modern hardware and software platforms. 3. PSO3: Design, develop and verify processes, algorithms and computer programs for medical purposes.
Programme Outcomes (POs)	**Engineering Graduates will be able to:** 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. 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. 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. 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.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
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.

Course Outcomes (COs)

Course	**Course code**	**Course Outcomes**
ODD sem 2019		
3rd SEMESTER		
ENGINEERING MATHEMATICS - III	19MA3BSEM3	CO 1 Apply Numerical techniques to solve problems arising in engineering. CO 2 Demonstrate an understanding of Fourier Series, Fourier Transforms and Z-Transforms. CO 3 Apply the concepts of calculus to functionals.
ELECTRICAL CIRCUIT ANALYSIS	19ES3GCECA	CO1 Formulate equations based on physical laws and analyse the steady state behaviour of complex electric networks. CO2 Apply the knowledge of mathematics and graph theory to the solution of complex electrical networks. CO3 Apply mathematical and analytical techniques to analyse transient behaviour of networks.

			CO4 Analyse networks based on two port networks and Unbalanced three-phase load.
	ANALOG ELECTRONIC CIRCUITS	19ES3CCAEC	CO1: Ability to define, understand and explain the structure, V-I characteristics, working and applications of analog electronic components like diodes, Bipolar Junction Transistors (BJTs) and MOSFETs CO2: : Ability to apply the knowledge of KVL and KCL to obtain voltage /current/waveform at different points in analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers. CO3: Ability to analyse analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers etc. to obtain voltage /current/waveform at different points for given specifications. CO4: Ability to design analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers for given specifications. CO5: Ability to conduct experiments using analog electronic components and electronic instruments to function as switch, regulator, clippers, clampers, small signal amplifiers, oscillators, power amplifiers

			CO6: Ability to formulate, design, implement, analyse, document and demonstrate an application using analog Electronic components through an open ended experiment, Document and present the same.
	DIGITAL ELECTRONIC CIRCUITS	19ES3CCDEC	CO1: Ability to understand, define and explain the fundamental concepts of Digital circuits CO2: Ability to apply the knowledge of simplification methods to optimize a Digital circuit CO3: Ability to analyze digital circuits and arrive at suitable conclusions CO4: Ability to design a digital circuit for given specifications CO5: Ability to conduct experiments using digital ICs for a given application/problem statement
	HUMAN PHYSIOLOGY AND MEDICAL PHYSICS	19ML3ESHPM	CO1 Use anatomical terminology to identify and analyze the physiology of and physics of human system CO2 Understand the interplay between different organ systems and how organs interact to maintain biological equilibrium in the face of a variable and changing environment. CO3 Use of modern tools to obtain information about physiology of all systems pertaining to human, analyze data and communicate with the instructor.
	SENSORS AND MEASUREMENTS	19ES3GCSME	CO1 : Apply the knowledge of science and engineering fundamentals to realize sensor based measurement systems. CO2 : Analyse engineering problems and performance characteristics in order to

			arrive at suitable techniques for the measurement of non-electrical quantities using direct or complex sensors. CO3: Design sensors and solutions to meet the specified measurement needs, considering the nature and properties of measured quantities. CO4 : Work with sensors and measurement systems both individually and in teams, document the activity and communicate the outcome to an engineering community.
	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS	19HS3ICCPH/ 19HS4ICCPH	CO1: Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land. CO2: Analyze the concepts and ideas of Human Rights. CO3: Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
	5TH SEMESTER		
	Biomedical Instrumentation	16ML5DC BMI	CO1: Apply knowledge of mathematics science and engineering fundamentals in designing, analyzing and/or working of biomedical circuits and instruments. CO2: Understand the health, safety, Environmental, legal and ethical issues while designing/working of a biomedical circuits and instruments. CO3: Work, document and present as an individual and as a team-member to design, formulate and implement experiments using modern equipment's & tools.

			CO4: Present in a group and document the findings or suggestions for the problems in the current techniques, modern tools and computing practice to improve technology in health care instruments through hospital visits for lifelong learning.
	Biomechanics and Rehabiliation	16ML5DC BMR	CO1: Ability to apply knowledge of mathematics, science and engineering to understand the fundamentals of moving systems and familiarity with human anatomy to competently analyze the movement of the human body. Co2: Ability to analyze the dynamics of human movement flow properties of blood and comprehend the biomechanical principles that relate to movement and communication disabilities. CO3: Ability to discuss, develop and apply the principles of biomechanics to a range of rehabilitation strategies and problem solving.
	Digital Signal Processing	16ML5DC DSP	CO1: To apply knowledge of Mathematics and Engineering to understand Sampling and Reconstruction of signals from the given samples. CO2: An ability to identify and analyze a problem and formulate the computing requirements to determine the spectrum of the given signals. CO3: An ability to implement the processes of FFT to reduce the computational complexity and to increase the speed and to attenuate noise.

			CO4: An ability to understand and formulate algorithms using the Multirate signal processing for sampling rate conversion in signal analysis and transmission. CO5: An ability to use current techniques and modern tools to improve the Medical data analysis.
	Medical Physics	16ML5DC MDP	CO1: Apply the knowledge of mathematics, science and engineering to understand the concepts of Human Physiology CO2: Identify and analyze a problem related to physics in heat, energy, work, power, pressure, sound and light applied to human body CO3: Understand the health and safety issues through physics concepts applied to human body CO4: Function and engage in communicating the recent trends in medical Physics.
	Oops with C++ for Medical Application	15ML5DE1 OP	CO1: Able to differentiate between structure oriented programming and object oriented programming and use object oriented programming language like C++ and associated libraries to develop object oriented programs for handling Medical data CO2: Ability to identify, analyze and apply the concepts of classes, Objects and other advanced OOPs concepts like inheritance, data abstraction, encapsulation, operator overloading, functions, polymorphism, exception handling for Medical data management

			CO3: ability to formulate, design, implement, analyze, demonstrate, document and present the concepts as application to healthcare implemented in groups or individual.
	Medical Device Testing on Substainabilti y	16ML 7DC MDT	CO1: Understand and apply modern software testing processes in relation to software development and testing. CO2: Implement test strategies and plans, design test cases, prioritize and execute them. CO3: Apply testing protocols for Medical devices and analyze preventive maintenance measures for sustainability. CO4: Apply the concepts learnt to device testing and maintenance of specific medical device in a group, record and present.
	Clinical Data Analytics	16ML 7DC CDA	CO1: Ability to apply knowledge of mathematics, science and Engineering to develop the solution using biostatistical concepts. CO2: Ability to analyse a problem and formulate appropriate solution for biostatistical concepts application. CO3: An ability to design and perform statistical test and interpret results CO4: Ability to implement and demonstrate statistical analysis using modern tool usage. CO5: Implement the concepts practically in group perform an

			open ended experiment /min project and document the same.
	Biomedical Circuits with VLSI	16 ML 7DE 2VM	CO1: Apply the knowledge of mathematics and engineering fundamentals to understand MOSFETs. CO2: Analyze VLSI circuits and arrive at suitable conclusions. CO3: Design VLSI circuits for given specifications. CO4: Design VLSI circuits for biomedical applications.
	Even sem 2019		
	4^{TH} SEMESTER		
	Engineering Mathematics - 4	19MA4BSEM4	Demonstrate an understanding of concepts of statistical analysis and probability distributions. Apply Numerical techniques to solve partial differential equations arising in engineering. Demonstrate an understanding of analytic functions and their application to evaluate integrals.
	PHYSIOLOGICAL CONTROL SYSTEMS	19ML4PCPCS	CO1: Obtain mathematical models of open loop and closed loop physical and physiological control systems CO2: Apply mathematical techniques to perform time response analysis of a physiological control system CO3: Carry out stability analysis using different mathematical techniques on physiological systems by system identification.
	LINEAR INTEGRATED CIRCUITS	19ES4CCLIC	CO1: Apply the knowledge of electronic engineering fundamentals to comprehend linear integrated circuits based systems

			CO2: Interpret and analyze the effects of DC and AC limitations of Operational Amplifiers CO3: Implement linear integrated circuits in the areas of power sourcing, signal generation and conditioning, and analog communication CO4: Design and develop analog sub-circuits for linear and non-linear applications CO5: Experiment and document the test results of various applications of linear integrated circuits, working both independently and in teams.
	MICROCONTROLLERS	19ES4GCMCS	CO1: Ability to understand and explain architecture of microprocessors and microcontrollers, pipelining, addressing modes, data types in Embedded C, serial communication, timer configuration and interrupt handling of microcontroller, memory expansion, control signal and wait states CO2: Ability to calculate instruction execution time, delay, baud rate, and develop assembly and C Code, identify the timer mode, serial communication mode and interrupt priorities CO3: Ability to design an 8051 system by interfacing 8051 to external memory , I/O, peripheral devices and external devices CO4: Ability to analyze the code in assembly as well as Embedded C CO5: Ability to conduct experiments by simulating, interfacing, debugging and executing the assembly and Embedded C code

		SIGNALS AND SYSTEMS	19ES4CCSAS	CO1: Ability to define, understand, and explain various types of signals, systems, their time and frequency domain representation and their realization. CO2: Ability to classify signals and systems, obtain the output for LTI systems using the time domain and the frequency domain representation, obtain the frequency domain representation of LTI systems using various transforms. CO3: Ability to analyse the given specifications for systems for causality, stability, linearity, time invariance and physical realizability. CO4: Ability to design LTI systems for the given response specifications in an efficient manner. CO5: Ability to make an effective oral presentation or report writing on contribution of signal processing in various engineering aspects.
		DIAGNOSTIC INSTRUMENTS	19ML4PCDIN	CO1: Apply knowledge of mathematics science and engineering fundamentals in Designing, analysing and/or working of biomedical circuits and instruments. CO2: Understand the health, safety, Environmental issues while Designing/working of a biomedical circuits and instruments. CO3: Present in a group and document the findings or suggestions for the problems in

			the current techniques, modern tools and computing practice to improve technology in health care instruments.
	CLINICAL IMMERSION	19ML4NCCIM	CO1 Gain exposure to methods that allow students to engage with stakeholders (doctors, clinic staff and patients) and give them the tools to understand the clinical environment. CO2 Learn the importance of empathy in design by analysing the user experience. CO3 Work in teams towards Incorporation of evidence-based practice to aid in health promotion analyze and synthesize data they have gathered throughout their clinical rotations through evaluative methods.
	Environmental studies	19HS4PCEVS	CO1: Understand the components and impacts of human activities on environment. CO2: Apply the environmental concepts for conservation and protection of natural resources. CO3: Identify and establish relationship between social, economical and ethical values from environmental perspectives.
	Bio-Materials and Artificial Organs	16ML6DCBMA	CO1: Apply knowledge of mathematics, science and engineering to understand the features of biomaterials and the biocompatibility phenomena. CO2: Understand the function and relationship between the structure and functionality of chosen artificial organ CO3: Comprehend an application of membrane materials in artificial organs and implants CO4: Analyze technical, ethical, economic, environmental and

			legal problems and formulate appropriate solution.
	Medical Device Development	16ML6DC MDD	CO1: Identify and analyse unmet clinical need and its requirements to solve it. CO2: Search, analyse and document clinical practice, engineering science and relevant literature in order to determine the need for further research and development in a chosen clinical area. CO3. Develop a sustainable business plan, including market overview, regulation strategies for health & safety of individuals and intellectual property (IP) strategies. CO4: Understand medical device design engineering and manufacturing process by avoiding common quality pitfalls in turn learning project management. CO5: Present the findings of the research in a team to peer audience
	Medical Imaging Modalities	16ML6DCMIM	CO1: Apply the knowledge of mathematics, science and engineering fundamentals to the solutions of complex problems using principles of medical imaging. CO2: Identify, formulate and analyse a problem in medical imaging applications to arrive at substantiated conclusions using Engineering sciences. CO3: Select and apply appropriate techniques, resources through virtual flat form IT tools including modelling

			to complex engineering activities with an understanding of the limitations in the medical imaging modalities. CO4: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the medical image modalities through hospital visit. CO5: Apply the ethical principles and understand the impact of the professional engineering solutions in societal, and environmental contexts, through the need for sustainable development to health care domain. CO6: Communicate and write reports in IEEE paper format effectively with the engineering community of health care domain as a member and as an individual in teams.
	Project management and Finance	16ML8DCPMF	CO1: Apply the Knowledge of project management principles and to implement project management methodologies required for successful project completion CO2: Develop Ethical principles in project planning and execution as a team and documentation inproject implementation. CO3: Identify and Apply finance aspects for project implantation in time. CO4: Use modern tools to simulate their respective projects and case studies and investigate

			thebehavior under various operating conditions.
	Intellectual Property rights & Cyber Law	16HS8GCIPL	CO1: Understand and analyze the basic principles of IP laws. CO2: Understand the basics, procedure and specifications of patents. CO3: Learn the basics of copy right and trade mark. CO4: Understand the need and necessity of Cyber law
	SOC for biomedical applications	16ML8DE3SB	CO1: Understand the fundamentals of ASIC and its design methods CO2: Understand ASICs and FPGAs, standard cells, cell libraries, IPs. CO3: To gain knowledge on programmable architectures for SOCs CO4: Understand the role of computer-aided design (CAD) tools in automating the design flow. CO5: To design a core from specs to GDSII for biomedical devices.
Name of the Programme	**M.Tech in Biomedical Signal Processing and Instrumentation**		
Programme Educational Objectives (PEOs)	1. **PEO1**: Become successful professionals and leaders in the domains of Biomedical signal processing, Instrumentation and allied fields of engineering. 2. **PEO2**: Engage in life-long learning processes through skill up gradation, research and development activities. 3. **PEO3:** Contribute to concurrent technological developments/changes, also demonstrating professional ethics.		

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF MEDICAL ELECTRONICS

Programme Outcomes (POs)	1. **PO1:**ability to independently carry out research /investigation and development work to solve practical problems 2. **PO2**: ability to write and present a substantial technical report/document 3. **PO3**: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

Course Outcomes (COs)

Course	Course Code	Course Outcomes
		ODD SEM 2019
Physiology for Biomedical Engineers	18MLBIPCPE	**CO1:** apply basic concepts of physiology for engineering analysis of human physiological systems **CO2:** translate the understanding of physiological functions into an engineering model. **CO3:** analyze and comprehend the model as an engineering solution.
Biomedical Image Processing and Analysis	18MLBIPCBA	CO1: Apply the fundamental concepts of Image processing for Biomedical Image analysis. CO2: Conduct experiments for medical image enhancement and segmentation. CO3: Implement open ended experiments for medical image analysis and prepare technical document.
Advanced Biomedical Instrumentation	18MLBIPCBI	CO1: Apply the comprehensive knowledge of electronic instrumentation techniques to solve practical problems in the domain. CO2: Write and present a significant technical report on a medical equipment or its functional element based on literature survey.

				CO3: Demonstrate skills to develop solutions based on multidisciplinary approaches for the measurement of Physiological parameters like ECG, EEG, EMG and Pressure.
		Real Time Bio Signal Processing	18MLBIPERS	CO1: Implement computationally efficient algorithms on the DSP platform for bio signals. CO2: Analyze real-time filter structures for performance evaluation using modern tools. CO3: Develop multirate signal processing algorithms for real-time bio signals as case study, and present a technical report on the same.
		Digital System Design using VERILOG	18MLBIPEDS	CO1: Design, simulate and synthesize digital circuits with Verilog. CO2: Evaluation of Digital circuits using EDA tools. CO3: Optimize the design for different parameters.
		Internship/Industrial Training	16MLBIPCIN	CO1: Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability CO2: Ability to use the techniques, skills, and modern engineering tools necessary for biomedical engineering practice CO3: Ability to function in multi-disciplinary teams CO4: Ability to make effective presentation of the internship

				work abiding professional ethics and societal responsibility. CO5: Ability to independently engage in the improvement of knowledge on contemporary issues in the domain.
		Project Phase- I	16MLBIPCP1	CO1: Ability to apply knowledge to identify, gather information and analyse to formulate the unmet need and problem definition for project through survey for biomedical domain CO2: Ability to use appropriate tool/tools to implement and demonstrate the project. CO3:Ability to design, solve and develop sustainable solution/system for the biomedical applications by understanding group dynamics & contributing to collaborative project work and its management at industry/institute CO4: Ability to make effective presentation of the work abiding professional ethics as an individual for lifelong learning. CO5: Ability to develop systems with scope for enhancement through reflective learning.

DEPARTMENT OF CHEMICAL ENGINEERING
BMS COLLEGE OF ENGINEERING, BENGALURU
Autonomous College under VTU

Academic Year 2019-20

Name of the Programme	**B.E. in Chemical Engineering**
Programme Specific Outcomes (PSOs)	PEO1: Graduates pursue profession in chemical & allied engineering PEO2: Graduates work in diversified team PEO3: Graduates will pursue higher education & research
Programme Outcomes (POs)	PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions PO5 **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. PO6 **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. PO7 **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. PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering

	community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11 **Project management and finance:** Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12 **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.
Course Outcomes (COs)	

THIRD SEMESTER

Course Title	**APPLIED MATHEMATICS**													
Course Code	**1**	**9**	**M**	**A**	**3**	**B**	**S**	**A**	**P**	**M**	**Credits**	**04**	**L – T – P**	**3 – 1 – 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

CO #	COURSE OUTCOME (CO)	PO's
CO 1	Apply Numerical techniques to solve problems arising in engineering.	PO1
CO 2	Demonstrate an understanding of Fourier Series and Fourier Transforms.	
CO 3	Apply the concepts of calculus to functionals.	

(Common to All Branches)

Course Title	**Additional Mathematics-I**													
Course Code	**1**	**9**	**M**	**A**	**3**	**I**	**M**	**M**	**A**	**T**	**Credits**	**00**	**L – T – P**	**3 – 1 – 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		
Contact hours	**48 hours (36L+12T)**										**III semester Lateral Entry students**			

On completion of the course, students will have the ability to:

CO #	COURSE OUTCOME (CO)	PO
CO 1	Understand the basic concepts of differentiation and integration.	PO1
CO 2	Apply the concepts of polar curves and multivariate calculus.	
CO 3	Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.	
CO 4	Apply techniques of vector calculus to engineering problems.	
CO 5	Comprehend the generalization of vector calculus in curvilinear coordinate system.	

DEPARTMENT OF CHEMICAL ENGINEERING
BMS COLLEGE OF ENGINEERING, BENGALURU
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Course Title	MATERIALS CHEMISTRY AND APPLICATIONS													
Course Code	1	9	C	Y	3	D	C	M	C	A	Credits	03	L – T – P	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

On completion of the course, the student will have the ability to:

Course outcomes:		PROGRAMME OUTCOMES
CO 1	Describe the principles of Chemistry involved in catalytic materials, ceramics, glass and lubricants.	PO1
CO 2	Apply the learnt principle of materials chemistry in addressing societal problems.	PO2
CO 3	Based on the acquired knowledge analyze the structure, topology, composition, catalytic properties and applications of materials.	PO2
CO 4	Understand to rationalise the main physical properties of soft materials in terms of their dependence on polymer composition, molecular weight and microstructure.	PO2
CO 5	Comprehend the impact of advance materials for sustainable development	PO7

Course Title	FLUID MECHANICS													
Course Code	1	9	C	H	3	D	C	F	M	E	Credits	04	L – T – P	3 – 0 – 1
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		
CO6	Recognize the need for lifelong learning for selecting suitable materials for industrial applications												PO12	

COURSE OUTCOMES (COs):

DEPARTMENT OF CHEMICAL ENGINEERING
BMS COLLEGE OF ENGINEERING, BENGALURU
Autonomous College under VTU

COURSE OUTCOMES		PROGRAMME OUTCOMES
CO1	Apply basic principles of pressure & conservation laws to solve fluid flow problems	PO1
CO2	Possess familiarity with the construction and working of fluid flow equipment with an understanding of the requirements of professional engineering practice	PO3
CO3	Develop correlations / solutions for flow processes that meet specific needs	PO3
CO4	Estimate energy requirements and losses in transportation and metering of fluids.	PO2
CO5	Conduct fluid flow experiments in team and derive valid conclusions.	PO9
CO6	Present the experimental observations in the form of a lab report.	PO2

Course Title	**MECHANICAL OPERATIONS**													
Course Code	**1**	**9**	**C**	**H**	**3**	**D**	**C**	**M**	**O**	**P**	**Credits**	**04**	**L – T – P**	**3 – 0 – 1**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES:

COURSE OUTCOMES		PROGRAMME OUTCOMES
CO1	Apply basic principles of mechanical operations	PO1
CO2	Develop solutions by applying mass and force balance for unit operations.	PO2

CO3	Analyse the working of equipment with an understanding of the requirements of professional engineering practice.	PO3
CO4	Apply the knowledge of solid-solid and gas-solid separation techniques for various applications including coal, mineral beneficiation, environmental pollution control etc.	PO4
CO5	Conduct experiments and evaluate in team for different mechanical operations to derive valid conclusion.	PO9
CO6	Present the experimental observations in the form of a lab report.	PO2

Course Title	**PROCESS ENGINEERING THERMODYNAMICS-I**													
Course Code	**1**	**9**	**C**	**H**	**3**	**D**	**C**	**T**	**D**	**1**	**Credits**	**03**	**L – T – P**	**3 – 0 – 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (Cos):

COURSE OUTCOMES		**PROGRAMME OUTCOMES**
CO1	Understanding of the fundamental concepts of thermodynamics viz. Closed/open/steady flow systems, Intensive and extensive properties, Equilibrium, Phase rule etc.	PO1
CO2	Knowledge of the inter-conversion of heat and work	PO1
CO3	Develop correlations for interrelated thermodynamic properties of systems.	PO3
CO4	Interpret the directional change by applying the thermodynamic concepts for steady state process.	PO4
CO5	Understand the concepts of entropy, enthalpy and Ideal gas equation and various gas Laws and thermodynamic processes	PO8

CO6	Ability to apply various thermodynamics laws to real systems	PO6

Course Title	**PROCESS PRINCIPLES AND CALCULATIONS**													
Course Code	**1**	**9**	**C**	**H**	**3**	**D**	**C**	**P**	**P**	**C**	**Credits**	**04**	**L – T – P**	**3 – 1– 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

	COURSE OUTCOMES	PROGRAMME OUTCOMES
CO1	Familiarity with conversion of units and dimensional consistency of equations	PO1
CO2	Formulate material balances for processes involving single/ multiple components with/without reactions.	PO2
CO3	Solve material for processes involving single/ multiple components without reactions.	PO2
CO4	Perform material balance calculations for chemical reaction.	PO3
CO5	Apply the basics of material balance for air-fuel ratio calculations, excess and limiting reactant calculations	PO3
CO6	Formulate and solve energy balance equations for various reactions.	PO3

Course Title	**ENVIRONMENTAL STUDIES AND POLLUTION CONTROL**													
Course Code	**1**	**9**	**C**	**H**	**3**	**H**	**S**	**E**	**S**	**P**	**Credits**	**03**	**L – T – P**	**3– 0 – 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES		Programme Outcomes
CO1	Understand the effect of environmental pollution on ecosystem	PO6
CO2	Identify the impact of recovery, recycle and reuse for sustainable development.	PO7
CO3	Engage in lifelong learning for abatement and control of environmental pollution	PO12
CO4	To acquire analytical skills in assessing environmental impacts through a multidisciplinary approach	PO2
CO5	Make an informed choice of equipment for pollution control.	PO6
CO6	Develop practical, efficient, cost effective and ethical solutions for challenges in environmental sciences and engineering.	PO8

Course Title	**PERSONALITY DEVELOPMENT AND COMMUNICATION SKILLS**													
Course Code	**1**	**9**	**H**	**S**	**3**	**N**	**C**	**P**	**D**	**C**	**Credits**	**00**	**L – T – P**	**1 – 0 – 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES:

COURSE OUTCOMES		Programme Outcomes
CO1	Understand and explain the aspects of personality development, team development, communication skills, time and stress management	PO9
CO2	Apply the principles of communication for functional effectiveness	PO10
CO3	Analyse the behavioural dimensions of individuals which have far reaching	PO10

	impact in the development of an organization	
CO4	Effectively communicate through verbal/oral communication and improve the listening skills	PO9
CO5	Actively participate in group discussion / meetings / interviews and prepare & deliver presentations	PO10
CO6	Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality	PO9

FOURTH SEMESTER

Course Title	STATISTICS AND PROBABILITY													
Course Code	1	9	M	A	4	B	S	S	A	P	Credits	03	L – T – P	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

On Completion of the course the student will have the ability to:

CO #	COURSE OUTCOME (CO)	PO
CO 1	Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples.	1,2,9,10
CO 2	Apply the basic principles of probability and Probability distributions to the problems in Engineering.	1,2
CO 3	Apply the concepts of Markov chain to the field of genetics.	1,2
CO 4	Demonstrate an understanding of sampling distributions and principles of experimental design.	1,2
CO5	Describe and discuss the key terminology, concepts tools and techniques used in business statistical analysis	1,2
CO6	Design experiments, carry them out, and analyze the data they yield	1,2

Course Title	PROCESS ENGINEERING THERMODYNAMICS-II													
Course Code	1	9	C	H	4	D	C	T	D	2	Credits	04	L–T–P	3–1–0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (COs):

COURSE OUTCOMES		PROGRAMME OUTCOMES
CO1	Apply the knowledge of classical thermodynamics to predict the thermodynamic properties of ideal and real gases	PO1

CO2	Derive thermodynamic relations between thermodynamic properties	PO2
CO3	Estimate properties of ideal and real gases from the thermodynamic relations.	PO2
CO4	Apply equations of state for describing the phase behaviour of various fluids.	PO3
CO5	Evaluate the equilibrium conversion in a reversible reaction using the Gibbs phase rule criteria	PO3
CO6	Assessment of the phase behaviour and equilibrium data of both pure and multicomponent systems by using phase equilibrium criteria.	PO3

Course Title	**PROCESS HEAT TRANSFER**													
Course Code	**1**	**9**	**C**	**H**	**4**	**D**	**C**	**H**	**T**	**R**	**Credits**	**04**	**L – T – P**	**3 – 0 – 1**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES		**PROGRAMME OUTCOMES**
CO1	Understand the principles of heat transfers and perform heat flux calculations for constant & variable area elements	PO2
CO2	Estimation of optimum insulation thickness and select different shapes of extended surfaces to enhance overall heat transferee co-efficient.	PO2
CO3	Perform preliminary design of heat transfer equipment using data with and without phase change	PO3
CO4	Comprehend and apply the laws governing radiation mode	PO2
CO5	Conduct experiments in teams and estimate the heat transfer co-efficient for fluids with and without phase change	PO9
CO6	Present the experimental observations in the form of a lab report.	PO2

Course Title	ANALYTICAL INSTRUMENTS													
Course Code	1	9	C	H	4	D	C	A	N	I	Credits	04	L – T – P	3 – 0– 1
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (Cos):

COURSE OUTCOMES		PROGRAMME OUTCOMES
CO1	Understand the theoretical concepts behind the functioning of analytical instruments	PO1
CO2	Understand the impact, complexity, strength and limitations of each instrument	PO2
CO3	Select suitable instruments based on their applicability	PO2
CO4	Conduct experiments in teams using various instruments for physical and chemical analysis	PO9
CO5	Present the experimental observations in the form of a lab report.	PO2
CO6	Ability to engage in life-long learning in context of technological change in instrumentations.	PO12

Course Title	MASS TRANSFER-I													
Course Code	1	9	C	H	4	D	C	M	T	1	Credits	03	L – T – P	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	PROGRAMME OUTCOMES

CO1	Formulate equations to estimate diffusivities in fluids and solids using first principles of engineering sciences	PO2
CO2	Apprehend the analogies in transport processes for validating and reaching substantiated conclusions.	PO3
CO3	Apply mass transfer fundamentals to calculate rates of mass transfer.	PO2
CO4	Knowledge of the operation/mechanism of adsorption, ion-exchange and crystallization.	PO7
CO5	Understanding of the concept and operation of various types of gas liquid contacts equipment.	PO3
CO6	Design the system components for various mass transfer operations.	PO3

Course Title	**CONSTITUTION OF INDIA-PROFESSIONAL ETHICS AND HUMAN RIGHTS**													
Course Code	**1**	**9**	**I**	**C**	**4**	**H**	**S**	**C**	**P**	**H**	**Credits**	**01**	**L – T – P**	**0 – 0 – 1**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

Course Outcomes:

COURSE OUTCOMES		**PROGRAMME OUTCOMES**
CO1	Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land.	PO6
CO2	Analyse the concepts and ideas of Human Rights.	PO6
CO3	Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.	PO8
CO4	Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations	PO8
CO5	Appreciate the Ethical issues and Know the code of ethics adopted in various professional body's and industries	PO8
CO6	Appreciate the Ethical issues and Know the code of ethics adopted in various professional body's and industries	PO8

Course Title	CHEMICAL PLANT UTILITIES													
Course Code	1	9	C	H	4	D	E	L	A	1	Credits	03	L – T – P	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (COs):

	COURSE OUTCOMES	PROGRAMME OUTCOMES
CO1	Enlist the applications of utilities in chemical processes	PO1
CO2	Identify the equipment used for a utility, describe their construction and working.	PO1
CO3	Apply thermodynamic principles involved in utility generation and perform the relevant calculations.	PO3
CO4	Compare equipment based on their relative advantages and disadvantages.	PO6
CO5	Evaluate equipment based on their performance and efficiency calculations	PO7
CO6	Aim for sustainable development in process by selecting suitable alternatives	PO7

Course Title	FOOD ENGINEERING													
Course Code	1	9	C	H	4	D	E	L	A	2	Credits	03	L – T – P-	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (COs):

COURSE OUTCOMES		Programme Outcomes
CO1	Identify sources of contaminants, adulterants and hazard analysis to ensure the safe food processing.	PO2
CO2	Understand the need of food additives and its safety aspects	PO2
CO3	Comprehend the engineering solutions for preservation of food	PO2
CO4	Understand the impact of nutritional properties of food on societal and health	PO6
CO5	Comprehend the engineering solutions involved in the packaging improvements for sustainable development of food industry.	PO7
CO6	Discern different technological change and recent advancements involved in food preservation	PO12

Course Title	ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT													
Course Code	1	9	H	S	4	C	H	E	D	M	Credits	03	L – T – P	3 – 0 – 0
CIE	100 marks (50% weightage)										SEE	100 marks (50% weightage)		

COURSE OUTCOMES (COs):

COURSE OUTCOMES		PROGRAMME OUTCOMES
CO1	Knowledge of management concepts and their evolution for professional engineering practice	PO6
CO2	Apply managerial skills and develop the necessary attributes to function effectively in diverse teams.	PO9
CO3	Ability to explore for business opportunities.	PO12
CO4	Compile information about the support available from various agencies for starting an enterprise	PO11
CO5	Possess knowledge of the entrepreneurial process	PO11
CO6	Ability to formulate, prepare and present a project report.	PO10

SEMESTER V Cluster CHEMICAL

Subject	CHEMICAL REACTION ENGINEERING-1	Credits	5

Sub.Code	**1**	**5**	**C**	**H**	**5**	**D**	**C**	**C**	**R**	**1**	**L-T-P-**	**4**	**0**	**1**

Course Outcomes

CO 1. Develop rate equations for different reactions using suitable mechanism.
CO 2. Fit the experimental data to obtain the rate equation and also to find the performance equation of ideal systems.
CO 3. Determine optimal ideal reactor design for multiple reactions & predict reactor performance for non-isothermal conditions.

Subject	MASS TRANSFER – 1										Credits	5		
Sub.Code	1	0	C	H	5	D	C	M	T	1	L-T-P	4	0	1

Course Outcome
CO 1. Determination of diffusivities in fluids & solids and analogies amongst the transport processes.
CO 2. Apply mass transfer fundamentals to calculate rates of mass transfer for various operations.
CO 3. Get the knowledge of the principles of novel separation process.

Subject	Pollution Control and Management										Credits	3		
Sub. Code	1	4	C	H	5	D	C	P	C	L	L-T-P	2	0	0

Course Outcome
CO 1. Identify the components of environmental eco systems and effect of pollutant on environment.
CO 2. Characterize the various parameters for treatment of water, waste water as well as solid waste from their sources.
CO 3. Recover and recycle the useful resources from the wastes by adopting advanced techniques.
CO 4. Identify suitable equipments for abatement and control of air and noise pollution.

Subject	CHEMICAL EQUIPMENT DESIGN										Credits	4		
Sub. Code	1	1	C	H	5	D	C	C	E	D	L-T-P	4	0	0

Course Outcome
CO 1. Realize the practical applications of basic engineering design principles.
CO 2. Select the suitable materials based on the process, environmental, economic & safety.
CO 3. Solve the numerical problems of various reaction/pressure vessel components.
CO 4. Estimation of sizing of pipes, pumps & storage vessel with its accessories.

Subject	FOOD ENGINEERING										Credits	4		
Sub. Code	1	4	C	H	5	D	E	L	A	1	L-T-P	4	0	0

Course Outcome
CO 1. Comprehend the physical properties of food and its transportation.
CO 2. Identify sources of contaminants, adulterants with its prevention for safe and healthy food.
CO 3. Discern different technologies involved in food processing & preservation.
CO4: Select biocompatible packaging and additives for food products.

Subject	PETROLEUM REFINING										Credits	4		
Sub. Code	1	4	C	H	5	D	E	L	A	2	L-T-P	4	0	0

Course Outcome
CO 1. Infer & identify data of composition and thermal properties in refining and treatment of petroleum.
CO 2. Familiarise with the different reforming techniques used for petroleum.
CO 3. Get acquainted with cracking processes to obtain desired product.

SEMESTER V Cluster CHEMICAL

Subject	NANO TECHNOLOGY										Credits	4		
Sub. Code	1	4	C	H	5	D	E	L	B	1	L-T-P	4	0	0

Course Outcome
CO 1. Apprehend different instrumental techniques to characterize nanopartices for their morphology and structure
CO 2. Select suitable fabrication techniques for synthesis of nanopartices, ferromagnetic materials, quantum nanostructures, MEMS and NEMS.
CO 3. Comprehend the application of nanomaterials in sensors, Lab on chip devices and drug delivery systems.

Subject	POLYMER PROCESSING										Credits	4		
Sub. Code	1	2	C	H	5	D	E	L	B	2	L-T-P	4	0	0

Course Outcome
CO 1. Apprehend molten flow behaviour of polymer.
CO 2. Familiarise with various processing techniques.
CO 3. Select suitable techniques based on applications.

Subject	CHEMICALREACTION ENGINEERING-II										Credits	4		
Sub. Code	1	3	C	H	6	D	C	C	R	2	L-T-P	4	0	0

Course Outcome
CO 1.Distinguish the performance of non-idealwith ideal systems.
CO2.Determine rate expression using reaction mechanisms of suitable model for catalytic & noncatalytic reactions.
CO.3. Develop design equation using models for heterogeneous reaction systems.

SEMESTER VI Cluster CHEMICAL

Subject	Instrumentation and Process Control										Credits	5		
Sub. Code	1	0	C	H	6	D	C	I	P	C	L-T-P	4	0	1

Course Outcome
CO 1.Identify the appropriate instruments for a application and evaluate its performance.
CO 2.Formulate transfer functions and predict responses to various forcing functions.
CO 3.Evaluate the response behaviour of P, PI, PD and PID controllers.
CO 4.Verify the stability of control systems.

Subject	MASS TRANSFER-II										Credits	5		
Sub. Code	1	0	C	H	6	D	C	M	T	2	L-T-P	4	0	1

Course Outcome
CO 1. Apply mass balance and composition balance in interfacial mass transfer.
CO 2. Apply the concept of interfacial mass transfer in multiphase contact processes.
CO 3. Design & working of various mass transfer equipment

Subject	Transport Phenomena										Credits	4		
Sub. Code	1	3	C	H	6	D	C	T	R	P	L-T-P	4	0	0

Course Outcome
CO1. Analyze the steady state operations for momentum, heat & mass transfers to interpret practical data.
CO2. Apply broad reasoning for shell momentum, energy & mass balances for laminar flows across various geometry and boundary conditions.
CO3. Understand the impact of equation of changes in various co-ordinate systems with its influence on analogies between momentum, heat and mass transport.

Subject	APPLIEDMATHEMATICSIN CHEMICALENGINEERING										Credits	3		
Sub. Code	1	3	C	H	6	D	E	L	C	1	L-T-P	3	0	0

Course Outcome
CO 1.Develop ordinary and partial differential equations to solve Chemical engineering problems.
CO 2.Use suitable numerical methods to solve the developed differential equations.
CO 3.Apply finite difference method to solve unit operations and processes.

Subject	OPERATIONS RESEARCH										Credits	3		
Sub. Code	1	0	C	H	6	D	E	L	C	2	L-T-P	3	0	0

Course Outcome
CO 1.Get acquainted to find optimum solutions for numerical problems using LPP. CO 2.Solve assignment, transportation and sequencing problems for its optimal solutions.
CO 3.Illustrate network constructions and find its feasible solutions for optimization of societal problems.

Subject	Computer Interface in Chemical Engineering										Credits	3		
Sub. Code	1	4	C	H	6	D	E	L	D	1	L-T-P	3	0	0

Course Outcome
CO 1.Comprehend the basics of C-programming and MAT lab for solving chemical engineering problems
CO 2. Apply suitable numerical methods to solve iterative chemical engineering problems
CO 3.Apply C-programming concepts to design and interpret the behavior of mass, heat transfer and reaction engineering operations

Subject	Interfacial phenomena and related separation techniques										Credits	3		
Sub. Code	1	1	C	H	6	D	E	L	D	2	L-T-P	3	0	0

Course Outcome
CO 1. Comprehend the concept of surface and interfacial tension and select surface tension measuring instruments for measuring tensions.
CO 2. Analyse the factors influencing stability of emulsions.
CO 3. Comprehend about detergency, surfactants and their applications.

SEMESTER VII Cluster CHEMICAL

Course Title	**CHEMICAL PLANT UTILITIES**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**C**	**C**	**P**	**U**	**Credits**	**03**	**L – T – P-S**	**3 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES	
CO1	Apprehend different utilities required for chemical plants
CO2	Select suitable type of equipment for pressure and vacuum
CO3	Equipment required for steam and co-generation
CO4	Equipment required for cooling processes
CO5	Identify Contaminants present in water and its treatment methods
CO6	Concepts of conservation of fuel, power and water by applying norms of good Engineering practice

Course Title	**BIOCHEMICAL ENGINEERING**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**C**	**B**	**C**	**E**	**Credits**	**03**	**L – T – P-S**	**3 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES	
CO1	Apply biology in bioprocess engineering
CO2	Understand functioning of molecules of life
CO3	Infer features of bioreactors to decide various processes
CO4	Identify enzymes for catalysed processes
CO5	Explain the kinetics of enzyme catalysed reaction
CO6	Perform the basis analytical techniques in downstream processing.

Course Title	**CHEMICAL PROCESS EQUIPMENT DESIGN & DRAWING**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**C**	**P**	**E**	**D**	**Credits**	**06**	**L – T – P-S**	**3 –0 – 1 - 2**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES	
CO1	Congregate the data from the literature, Handbook, Code book
CO2	Analyze, interpret the literature data
CO3	Design the heat and mass transfer equipment
CO4	Select the details of accessories based on technical needs and availability
CO5	Decide on the incorporation of inherent safety standards
CO6	Draft the equipment as per the design

Course Title	**CHEMICAL PROCESS MODELLING & SIMULATION**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**C**	**P**	**M**	**S**	**Credits**	**05**	**L – T – P-S**	**2 – 0 – 1 - 2**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES	
CO1	Understand the physical laws and mathematical models for reactor modules
CO2	Select suitable shell balance approach to build models for heat transfer
CO3	Select suitable shell balance approach to build models for separation processes
CO4	Apply the simulation principles to solve build in models for reactors, heat transfer and separation processes
CO5	Conduct Simulation experiments individually and in team using UNISIM
CO6	Infer and interpret the simulation data by applying norms of Engineering practice

Course Title	**ENGINEERING ECONOMICS**													
Course Code	**1**	**6**	**H**	**S**	**7**	**D**	**C**	**E**	**I**	**E**	**Credits**	**02**	**L – T – P-S**	**2 – 0 – 0-0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES	
CO1	Identify the factors while selecting plant location, plant layout and feasibility survey
CO2	Solve the problems related to estimation of product cost by making use of various costs
CO3	Differentiate different types of taxes and interest
CO4	Solve problems related to depreciation and interest
CO5	Obtain break-even point for a given production of materials and profit and loss statement
CO6	Create a balance sheet of an industry by considering various factors

Course Title	**PRE-PROJECT WORK**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**C**	**P**	**P**	**W**	**Credits**	**02**	**L – T – P-S**	**0 – 0 – 2 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50%**		

			weightage)

A project is assigned at the beginning of the seventh semester. The project group should complete the preliminary literature survey & plan of project and submit the synopsis at the end of seventh semester with a literature survey and plan for the experimental work to be performed with all parameters.

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Perform extensive literature survey to understand the changes in the technological trends
CO2	Identify a feasible method to carry out the project work by considering professional ethics of engineering practice
CO3	To formulate one or more methodological approach to carry out the experiments to find a feasible solution for societal & environmental problems.
CO4	Communicate and present/publish effectively the methodological planned to carry out the project work.
CO5	Develop multidisciplinary skills to work as an individual and as a member or leader in diverse team
CO6	Relate the outcomes of the project where the knowledge on developed understanding will help in lifelong learning so as to suit the current technological trends

Course Title	**FINITE ELEMENT ANALYSIS**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**E**	**L**	**E**	**1**	**Credits**	**01**	**L – T – P-S**	**1 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Develop shape functions and stiffness matrices for spring and bar elements
CO2	Develop global stiffness matrices and global load vectors
CO3	Apply natural and arial coordinate systems to constant strain triangle and linear strain triangle elements
CO4	Analyze planar structural systems using finite element modelling

Course Title	**FERMENTATION TECHNOLOGY**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**E**	**L**	**E**	**2**	**Credits**	**01**	**L – T – P-S**	**1 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Introduce the students to the various concepts of fermentation
CO2	Introduce the students to the role microorganism play in fermentation process

CO3	Provide the students with the process understanding of alcoholic various fermentation processes.

Course Title	**SMART MATERIALS**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**E**	**L**	**E**	**3**	**Credits**	**01**	**L – T – P- S**	**1 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Knowledge and awareness of smart materials and concepts to engineering application areas
CO2	Critical understanding of mechanisms giving rise to the characteristic and beneficial properties of smart materials
CO3	Understanding of material systems that underlie the analysis and design of “smart” devices

Course Title	**SKADA AND PLC**													
Course Code	**1**	**6**	**C**	**H**	**7**	**D**	**E**	**L**	**E**	**4**	**Credits**	**01**	**L – T – P- S**	**1 – 0 – 0- 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Explain the basic concepts, terminology, programming functions and entry level PLC applications.
CO2	Enumerate applications, sketch the architecture and describe major elements of SCADA.
CO3	List the communication requirements; describe protocols and structure of a SCADA Communications Protocol.

Course Title	**Composite Materials**													
Course Code	**1**	**6**	**C**	**H**	**7**	**I**	**E**	**C**	**P**	**1**	**Credits**	**03**	**L – T – P- S**	**3 – 0 – 0- 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Classify composite materials based on the Industrials applications
CO2	Apprehend and select a suitable fabrication technique for processing of ceramic materials.
CO3	Distinguish between mechanical and chemical techniques for fabrication of composite materials
CO4	Custom the synthesized metal- matrix and ceramic-matrix composite materials to use in different engineering disciplines.

CO5	Comprehend the fabrication techniques for reinforced polymer materials to demonstrate the knowledge of sustainable development.

Course Title	**Non-Conventional Energy Technology**													
Course Code	**1**	**6**	**C**	**H**	**7**	**I**	**E**	**C**	**P**	**2**	**Credits**	**03**	**L – T – P- S**	**3 – 0 – 0- 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Familiarize with the various forms of energy resources
CO2	Understand the global distribution of energy recourses with its environmental impacts.
CO3	Familiarize the various non-conventional energy resources
CO4	Design and Develop the requirements for economical utilization of non-conventional energy sources.
CO5	Design basic aspects to establish non-conventional energy harvesting units

Course Title	**Management and Entrepreneurship**													
Course Code	**1**	**6**	**H**	**S**	**8**	**D**	**C**	**M**	**M**	**E**	**Credits**	**03**	**L – T – P- S**	**3 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Gain knowledge on Management concepts & its evolution.
CO2	Learn the application of Managerial skills & attributes.
CO3	Get an in depth knowledge of Entrepreneurial process & will be able to apply the Entrepreneurial skills.
CO4	Compile information & explore the business opportunities.
CO5	Able to prepare the Business plan.

Course Title	**Project Management and Finance**													
Course Code	**1**	**6**	**C**	**H**	**8**	**D**	**C**	**P**	**M**	**F**	**Credits**	**04**	**L – T – P- S**	**2 – 0 – 0 - 2**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	To make the student understand the concept of a project with relevance to industry and chemical industry in particular.
CO2	To understand the various stages and procedures involved in conducting industrial projects.
CO3	To comprehend ideas like project selection, planning, implementation,

	success and review
CO4	Techniques of capital budgeting, venture capital generation with relevance to handling projects
CO5	Concepts of CPM and PERT, scheduling and forecasting with their importance in control of projects with change in technologies

Course Title	**FINAL PROJECT WORK**													
Course Code	**1**	**6**	**C**	**H**	**8**	**D**	**C**	**F**	**P**	**W**	**Credits**	**12**	**L – T – P- S**	**0 – 0 – 12- 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Design and carry out the experiments/design/theoretical design/ simulations work in team in the predetermined methodology.
CO2	Analyze and interpret the obtained data for optimum solution using suitable Engineering and IT tools.
CO3	Elucidate the short comings and identify the scope for future work
CO4	Communicate effectively the project the results/write effective reports to publicize the deduce solutions.
CO5	Develop ability to function and to work as an individual/ as a member/leader in diverse team
CO6	Understand the essence and need of professional ethics during project documentation

Course Title	**INTERNSHIP & RELATED SEMINAR**													
Course Code	**1**	**6**	**C**	**H**	**8**	**D**	**C**	**I**	**R**	**S**	**Credits**	**02**	**L – T – P- S**	**0 – 0 – 0- 2**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Communicate & report the industrial practices through technical presentations
CO2	Develop inter personal relationship and work as a member in diversified areas
CO3	Understand the need of engineering solutions for sustainability and environmental conservation
CO4	Understand the essence and need of industrial ethics
CO5	Get to know the role of economics and management principles in the success of industrial operation

Course Title	**Waste Water treatment**													
Course Code	**1**	**6**	**C**	**H**	**8**	**I**	**E**	**C**	**K**	**1**	**Credits**	**03**	**L – T – P- S**	**3 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Understanding the fundamentals and importance of Wastewater treatment and its objectives with the basic concept of contaminants and its effects on the environment
CO2	Understand the different streams of wastewater and its disposal on the natural environmental based on the assimilation criteria and rural water supply and sanitations with design criteria for sanitary, storm sewers.
CO3	Understanding the microbiology of wastewater and its importance during the treatment.
CO4	Understand the conventional wastewater treatment methods such as physical, chemical and biological with advanced treatment criteria based on the regional requirement.

Course Title	**Pilot Plant Studies**													
Course Code	**1**	**5**	**C**	**H**	**8**	**I**	**E**	**C**	**K**	**2**	**Credits**	**03**	**L – T – P-S**	**3 – 0 – 0 - 0**
CIE	**100 marks (50% weightage)**										**SEE**	**100 marks (50% weightage)**		

COURSE OUTCOMES (COs):

COURSE OUTCOMES	
CO1	Understand the concept of Pilot Plant Scale up.
CO2	Understand the principles of Similarity.
CO3	Understand the concept of different regimes for scale up.
CO4	Ability to scale up Mixing system and chemical reactors.
CO5	Ability to scale up Mass and Heat Transfer Processes

Name of the Programme	MTech in : **BIOCHEMICAL ENGINEERING**
Programme Educational Objectives (PEOs)	**PEO1:** Graduates pursue profession in chemical engineering and allied engineering **PEO2:** Graduates work in diversified team **PEO3:** Graduates will pursue higher education and research
Programme Outcomes (POs)	**PO1:** An ability to independently carry out research/investigation and development work to solve practical problems **PO2:** Ability to write and present a substantial technical report/document **PO3:** An ability to demonstrate mastery in the Biochemical Engineering, at the level higher than the undergraduate program in Chemical and Biotechnology Engineering.
Course Outcomes (COs)	

I SEMESTER M TECH BIOCHEMICAL ENGINEERING

MATHEMATICAL MODELING IN BIOCHEMICAL ENGINEERING -18CHBCPCMM

Subject Code	18CHBCBSMM	L-T-P	3-1-1
No of Lecture Hrs/Week	03+02 (Tutorials)	Exam hours	03
Total No. of Lecture Hours	39	Credits	05
CIE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Develop mathematical models for chemical and biochemical systems.

CO 2: Solve process models using different mathematical techniques.

CO 3: Analyze process models using advanced software tool

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOPROCESS ENGINEERING - 18CHBCPCBP

Subject Code	18CHBCPCBP	L-T-P	3-1-1
No of Lecture Hrs/Week	03+02 (Tutorials)	Exam hours	03
Total No. of Lecture Hours	39	Credit	05
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Demonstrate the biological systems for engineering applications that requires skills from the various disciplines

CO2: Classify and identify the enzymatic processes and kinetics essential to work in the area of bioprocessing to arrive at a kinetic model to effectively represent the physical system

CO3: Establish the skills in investigations of the experimental data to nurture analytical and critical thinking abilities for data based decision making

CO4: Describe about various cultures, reactors, bioprocess applications and industrial processes

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOREACTORS- 18CHBCPCBR

Subject Code	18CHBCPCBR	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	04
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO 1: Analyze and prepare a poster on the suitability of a bioreactor selecting from a wide choice of spectrum of bioreactors

CO 2: Apply the concept of transport processes in biological systems involving oxygen transfer, estimate the oxygen rates and coefficient with appropriate models

CO 3: Analyze the factors influencing the performance of bioreactors and apply judgment to select control systems to stabilize the parameters effecting the bioreactor performance

CO 4: Select the suitable modern tools to estimate the performance of the scaled up bioreactors and apply ethically a suitable sterilization process

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
TRANSPORT PHENOMENA IN BIOPROCESS SYSTEMS- 16CHBCPETP

Subject Code	18CHBCPETP	L-T-P	4-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	52	Credits	04
CIE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Apply continuity equations of change for real problems involving basic mass transfer systems, and determination of oxygen utilization as well as transfer rates

CO 2: Adjudge applicability of mass transfer correlation to determine coefficients for Newtonian & Non-Newtonian fluids

CO 3: Apply Modeling to estimate the distribution of temperature in solids and fluids flowing in laminar regime

CO 4: Apply appropriate mathematical techniques to predict, estimate the concentration distribution in fluids in laminar regime and estimate transfer coefficient

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOLOGICAL THERMODYNAMICS - 18CHBCPEBT

Subject Code	18CHBCPEBT	L-T-P	4-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	52	Credits	04
CEE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Understand and apply the laws of thermodynamics to analyze energy flows in a biological system.
CO 2: Evaluate Gibbs free energy and calculate attainable work for engineering and biological system.
CO3: Study and present a results for Gibbs free energy and reaction kinetics

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
NUMERICAL ANALYSIS – 18CHBCPENA

Subject Code	18CHBCPENA	L-T-P	4-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	52	Credits	04
CEE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Develop ordinary and partial differential equations to solve chemical and biochemical engineering problems
CO 2: Apply appropriate numerical techniques to solve ODE and PDEs
CO 3: Analyze error in the solution opt using numerical techniques and minimize the error
CO4: Apply proper regression and curve fitting method to analyze experimental data.

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
FOOD ENGINEERING - 18CHBCPEFE

Subject Code	18CHBCPEFE	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CEE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Comprehend the physical properties of food and its transportation
Identify the sources of contaminants, adulterants with its prevention for safe and healthy food
CO3: Identify different technologies involved in food processing and preservation and prepare document on technologies
CO 4: Select biocompatible packaging and additives for food products.

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOINSTRUMENTATION - 18CHBCPEBI

Subject Code	18CHBCPEBI	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CEE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Demonstrate an understanding of physics and engineering to explain the theoretical concepts governing the principle and functioning of the instrument
CO 2: Understand the design of the device, impact, complexity of each instrument, and its various models

CO 3: Analyze the data using theoretical knowledge from advance instruments for precise analysis CO4: Demonstrate the applications and interpret the experimental data

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
ANIMAL & PLANT CELL CULTURE TECHNIQUES - 18CHBCPEAP

Subject Code	18CHBCPEAP	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CEE	50 marks	SEE	50 marks
COURSE OUTCOMES CO1: Understand the characteristics of cells in scale up and large scale operation CO2 : Prepare, sterilize and harvest culture media using advanced techniques CO3 : Familiar with techniques for pharmaceutical and medical tissue products			

I SEMESTER M TECH BIOCHEMICAL ENGINEERING
INSTITUTE CORE
RESEARCH METHODOLOGY & IPR-18ALLPICRM

Subject Code	18ALLPICRM	L-T-P	2-0-0
No. of Lecture Hrs/Week	02	Exam hours	03
Total No. of Lecture Hours	26	Credits	02
CEE	50 marks	SEE	50 marks
COURSE OUTCOMES CO1 : Ability to write and present a substantial technical report/document CO2 : Able to demonstrate a degree of mastery over the area of specialization			

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
PROCESS AUTOMATION- 18CHBCPCPA

Subject Code	18CHBCPCPA	L-T-P	3-0-1
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	04
CIE	50 Marks	SEE	50 Marks
COURSE OUTCOMES CO 1: Analyze complex engineering problems and apply independent judgment for solving control problem involving open and close loops CO 2: Evaluate the stability for open loop systems using modern tools and apply the same for the process of modeling. CO 3: Use the modern tools and mathematical techniques in devising advanced control system and predict its performance.. CO 4: Analyze, experiment and interpret the stability of control systems by team.			

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
REACTION KINETICS – 18CHBCPCRK

Subject Code	18CHBCPCRK	L-T-P	3-1-0
No of Lecture Hrs/Week	03+02 (Tutorials)	Exam hours	03
Total No. of Lecture Hours	39	Credits	04
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Develop kinetic equations of heterogeneous reaction for catalytic and non – catalytic reaction using various models with and without consideration of effective mass and energy transport

CO2: Conduct experiment and analyze the flow behavior, contacting, conversion and performance of non-ideal reactors using various models and comparison with ideal reactor

CO3: Apply knowledge of reaction kinetics and flow behavior to design

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOSEPARATION & DOWNSTREAM PROCESSING- 18CHBCPCBD

Subject Code	18CHBCPCBD	L-T-P	3-0-1
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	04
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Apprehend the various downstream processes and select an unit operation to purify
the product suitable for a particular biological mixture

CO2: Assess the purity of the desired product using modern tools by selecting an appropriate separation process considering the economics and process feasibility

CO3: Use of membrane diffusion as a tool for separation with clear knowledge of applicability and limitations

CO4: Design a suitable polishing and packaging operation with focus on the market, economics and shelf life of the product

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOLOGICAL WASTE TREATMENT & ENGINEERING – 18CHBCPEBW

Subject Code	18CHBCPEBW	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO: Explain the different regulatory standards with design criteria for environmental parameters

CO2: Demonstrate the wastewater treatment criteria based on the regional requirement

CO3: Comprehend the reaction kinetics, reactor selection and its process analysis

CO4: Design the treatment plant based on the fundamentals studies, bench scale and pilot plant studies

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOMATERIALS & TISSUE ENGINEERING- 18CHBCPEBM

Subject Code	18CHBCPEBM	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO 1: Demonstrate the concepts of biocompatibility and other properties of

biomaterials
CO 2: Classify and characterize biomaterials
CO 3: Understand the synthesis and properties of biopolymers in use as biomaterials
CO 4: Demonstrate tissue engineering and applications

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
MEMBRANE SEPARATION TECHNOLOGY- 18CHBCPEMS

Subject Code	18CHBCPEMS	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES
CO 1: Classify and characterizer the membranes for bio separation.
CO 2: Understand the preparation of membranes
CO 3: Analyze and select the appropriate method of membrane and membrane process.
CO 4: Evaluate the flux of solvent and solute through membrane.

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
NANOTECHNOLOGY IN BIOPROCESS INDUSTRIES – 18CHBCPENB

Subject Code	18CHBCPENB	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES
CO1: Demonstrate the knowledge in the interface between chemistry, physics and biology on the nano structural level with a focus on bioprocess industries use
CO2: Diagnose the concepts of BioMEMS and their use in drug delivery
CO3: Demonstrate the available nanomaterials in biological system
CO4: Imply the significance of applications for economical use of nanomaterials

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
BIOSENSORS - 18CHBCPEBS

Subject Code	18CHBCPEBS	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES
CO1. Acquaint with the need of biosensors, types of sensors and their parameters
CO2. Understand the role of transducers in chemical analytics while working with biosensors.
CO3. Demonstrate the kinetic modeling of biosensors and biosensors applications in industrial online monitoring

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
PHARMACEUTICALS- 18CHBCPEPH

Subject Code	18CHBCPEPH	L-T-P	3-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	03

CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Emphasize the knowledge on biopharmaceuticals and to identify the pharmaceuticals of plant, animal and microbial origin
CO2: Analyze the sources of biopharmaceuticals and to identify various applications.
CO3: Design the biopharmaceutical manufacturing process and study the products using appropriate characterization technique
CO4: Design a suitable drug delivery process, inculcate critical thinking to perform clinical trials and to design advanced drug delivery systems

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
WASTE TO ENERGY – 18CHBCOEWE

Subject Code	18CHBCOEWE	L-T-P	4-0-0
No of Lecture Hrs/Week	03	Exam hours	03
Total No. of Lecture Hours	39	Credits	04
CIE Marks	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Establish the sources and composition of biomass and biomass characterization
CO2:Demonstrate production technologies, applications and also characterize the bioethanol and biodiesel
CO3:Demonstrate the biogas production technique and the design criteria of equipment
CO4: Determine the biomass processing techniques for the improvement of quality of biofuels

II SEMESTER M TECH BIOCHEMICAL ENGINEERING
GREEN TECHNOLOGY-18CHBCOEGT

Subject Code	18CHBCOEGT	L-T-P	4-0-0
No of Lecture Hrs/Week	04	Exam hours	03
Total No. of Lecture Hours	26	Credits	04
CIE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Demonstrate the tools of green technology and zero waste systems
CO 2: Apply the basic principles of green chemistry and atoms
CO 3: Demonstrate the life cycle assessment methods and tools
CO4: Develop methods of pollution prevention and to predict a better design for environment

III SEMESTER M TECH BIOCHEMICAL ENGINEERING
PROJECT WORK PHASE 1 - 18CHBCPWP1

Subject Code	18CHBCPWP1	Project Work Phase-1	0-0-16
No of Lecture Hrs/Week	---	Exam hours	03
Total No. of Lecture Hours	---	Credits	16
CIE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Select and define an appropriate research problem and parameters through literature review
CO2: Prepare a project review and also write protocols to perform the experiments in an organized manner
CO3: Conduct the research and present the work progress through seminars
CO4: Write a research proposal for the grant and carry out data analysis
CO5: Write precise project report with appropriate references

III SEMESTER M TECH BIOCHEMICAL ENGINEERING

SAFETY MANAGEMENT IN BIOPROCESS INDUSTRIES-18CHBCPESM

Subject Code	18CHBCPESM	L-T-P	4-0-0
No of Lecture Hrs/Week	02	Exam hours	03
Total No. of Lecture Hours	52	Credits	04
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Understand the biohazard and its abatement in a safe way
CO2: Demonstrate the risk analysis, assessment and abatement of hazards for the safe operation of processes in biochemical industries
CO3: Apprehend process safety in Biotechnological based products in order to comply with industrial & regulatory standards

III SEMESTER M TECH BIOCHEMICAL ENGINEERING

COST MANAGEMENT OF ENGINEERING PROJECTS - 18CHBCPECM

Subject Code	18CHBCPECM	L-T-P	4-0-0
No of Lecture Hrs/Week	02	Exam hours	03
Total No. of Lecture Hours	52	Credits	04
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives
CO2: Perform and evaluate payback period and capitalized cost on one or more economic alternatives
CO3: Carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives

III SEMESTER M TECH BIOCHEMICAL ENGINEERING

SEMINAR - 18CHBCPCSR

Subject Code	18CHBCPCSR	L-T-P	0-0-2
No of Lecture Hrs/Week	00	Exam hours	3
Total No. of Lecture Hours	00	Credits	02
CIE	50 Marks	SEE	50 Marks

COURSE OUTCOMES

CO1: Communicate orally, present the technical research work using modern tools
CO2: Address certain societal issues and find out solutions from the studies
CO3: Present solution for the sustainable development

CIE EVALUATION
The student shall study minimum four recent research publications/patents published and present the same as seminar.
The topic of the presentation shall be related to M Tech specialization/project work
Three presentations shall be given by the student on the topic during the semester evaluated by the faculty in charge of the course.
SEE EVALUATION
The topic presented during the CIE evaluation shall be presented. The SEE evaluation at the end of the semester shall be done in the presence of external examiner.

III SEMESTER M TECH BIOCHEMICAL ENGINEERING
AUDIT COURSE- ENGLISH FOR RESEARCH PAPER WRITING -18CHBCNCER

Subject Code	18CHBCNCER	L-T-P	2-0-0
No of Lecture Hrs/Week	00	Exam hours	00
Total No. of Lecture Hours	50	Credits	00
CIE	50 Marks	SEE	P/NP

COURSE OUTCOMES
CO1: Improve writing skills and level of readability
CO2: Excel the skills needed to write each section of a technical paper
CO3**:** Write conclusions through study and a good quality review paper

III SEMESTER M TECH BIOCHEMICAL ENGINEERING
AUDIT COURSE- VALUE EDUCATION -18CHBCNCVE

Subject Code	18CHBCNCVE	L-T-P	2-0-0
No of Lecture Hrs/Week	00	Exam hours	00
Total No. of Lecture Hours	50	Credits	00
CIE	50 Marks	SEE	P/NP

COURSE OUTCOMES
CO1; Acquire the knowledge of self-development
CO2: Demonstrate the importance of human values
CO3: Develop the overall personality

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
PROJECT WORK -PHASE 2 - 18CHBCPWP2

Subject Code	18CHBCPWP2	Project Work Phase - 2	0-0-12
No of Lecture Hrs/Week	---	Exam hours	3
Total No. of Lecture Hours	---	Credits	12
CIE	100 marks	SEE	100

COURSE OUTCOMES
CO1: Demonstrate research work as per the objectives set and suggestions by supervisors for the best outcomes of the work
CO2: Compute and analyze the experimental data
CO3: Publish the research work in a technical, and reputed journal

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
INTERNSHIP - 18CHBCPCIN

Subject Code	18CHBCPCIN	L-T-P	0-0-8
No of Lecture Hrs/Week	---	Exam hours	03
Total No. of Lecture Hours	---	Credits	08
CIE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Understand the functioning of chemical process industry
CO2: Demonstrate the knowledge on the recent developments in the area
CO3: Iintegrate the theoretical knowledge with practical processes
CO4: Communicate skillfully and work in interdisciplinary teams in industry
CO5: Recognize the professional and ethical responsibility

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
FERMENTATION TECHNOLOGY - 18CHBCPEFT

Subject Code	18CHBCPEFT	L-T-P	2-0-0
No of Lecture Hrs/Week	02	Exam hours	3
Total No. of Lecture Hours	26	Credits	02
CIE Marks	50 marks	SEE	50 marks

COURSE OUTCOMES

CO1: Demonstrate the science underlying the conversion of raw materials, various source, their quality and their influence on the properties of final products
CO2: Design, formulate and select the skills to perform committed laboratory exercises through sterilization and other activities
CO3: Distinguish the design and operation of basic methods of fermentation process
CO4: Acquaint with the apparatus and instruments for technical procedures used in the laboratory

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
ENZYME TECHNOLOGY- 18CHBCPEET

Subject Code	18CHBCPEET	L-T-P	2-0-0
No of Lecture Hrs/Week	02	Exam hours	03
Total No. of Lecture Hours	26	Credits	02
CEE	50 marks	SEE	50 marks

COURSE OUTCOMES

CO 1: Demonstrate the enzymes structure, properties, classification and their specificity
CO 2: Apply the knowledge to analyze the kinetics of reaction and arrive at a model representing the type of process
CO 3: Demonstrate the type of reaction through the analysis of the experimental data
CO 4: explain the industrial applications and analytical tools in use.

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
AUDIT COURSE PEDAGOGY STUDIES - 18CHBCNCPS

Subject Code	18CHBCNCPS	L-T-P	2-0-0
No of Lecture Hrs/Week	00	Exam hours	00
Total No. of Lecture Hours	50	Credits	00
CIE	50 Marks	SEE	P/NP

COURSE OUTCOMES

CO1: Demonstrate the pedagogical practices used by teachers in formal and informal classrooms in developing countries

CO2: Understand the effectiveness of the pedagogical practices, with respect to type of conditions, and population of learners

CO3: Demonstrate the support by the teacher education (curriculum and practicum) and the school curriculum and guidance materials for the best and effective pedagogy

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
AUDIT COURSE STRESS MANAGEMENT BY YOGA-18CHBCNCSY

Subject Code	18CHBCNCSY	L-T-P	2-0-0
No of Lecture Hrs/Week	00	Exam hours	00
Total No. of Lecture Hours	50	Credits	00
CIE	50 Marks	SEE	P/NP

COURSE OUTCOMES

CO1: Develop healthy mind in a healthy body thus improving social health also

CO2: Improve efficiency by overcoming stress

CO3: Demonstrate the uses orally and exercises physically

IV SEMESTER M TECH BIOCHEMICAL ENGINEERING
AUDIT COURSE DISASTER MANAGEMENT - 18CHBCNCDM

Subject Code	18CHBCNCDM	L-T-P	2-0-0
No of Lecture Hrs/Week	00	Exam hours	00
Total No. of Lecture Hours	50	Credits	00
CIE	50 Marks	SEE	P/NP

COURSE OUTCOMES

CO1: Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO2: Evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO4: Demonstrate the strengths and weaknesses of disaster management approaches, planning and programming

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous Institute, Affiliated to VTU

DEPARTMENT OF BIOTECHNOLOGY

Academic Year 2019-20

Name of the Programme	**B.E. in BIOTECHNOLOGY**
Programme Specific Outcomes (PSOs)	1. Apply knowledge of basic sciences and biotechnological techniques to manipulate living organisms 2. Design, optimize, analyse and scale up a bioprocess to develop value added products 3. Generate, analyse and interpret Biological data using Insilco approaches.
Programme Outcomes (POs)	PO1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2 Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. PO5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. PO6 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. PO7 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. PO8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. PO12 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.

Course Outcomes (COs)	
3rd Semester	
Basics of Biomolecules (19 BT3DCBBM)	CO1 Understand, define and explain concepts of structure and function of biomolecules CO2 Apply the concept of solution chemistry to compute the numerical problems related to preparation of solutions and buffers.

	CO3 Analyse the structural aspects of biomolecules and interpret the data. CO4 Design solutions to the challenges associated with dependence of functional aspects of biomolecules on the structure CO5 Design and conduct experiments related to qualitative analysis of biomolecules and prepare solutions /buffers Co 6 (open ended expts.) Have the ability to individually search, read, and understand technical literature related to biomolecules and effectively design, conduct experiments & interpret data obtained based on the technical literature reviewed as well as be able to write a technical report
Microbiology (19BT3DCMBG)	CO 1 Understand the working principle and importance of various microscopes in analysis of physicochemical properties of microorganisms. CO 2 Analyse and determine the growth, invitro culturing, physicochemical properties and controlling of microorganisms. CO 3 Select and apply appropriate microorganisms and their value-added products in various applications CO 4 Design, conduct experiments, analyse and interpret the data pertain to biochemical and metabolic potential of microorganisms.
Process Principles & Calculations (19BT3DCPPC)	CO 1 Comprehend the basic concepts of process calculations in biochemical engineering applications. CO 2 Apply the knowledge of process calculations on material and energy balances on steady state unit operations involving with & without reactions. CO 3 Analyze the stoichiometric equations for microbial growth & product formation for material balance calculations. CO 4 Design the psychometric chart, study state unit operation material balance equations for with and without reactions. CO 5 Deliver a seminar on the topic related to the course.

Basics of computer applications (19BT3DCBCA)	CO1 Comprehend the concept of operating system, DBMS and computer languages. CO2 Apply the concept of SQL to create and constitute the PERL scripts for various applications. CO3 Analyze the data using Python and MATLAB and deduce ER diagrams. CO4 Conduct experiments to create and access the databases, execute the Perl scripts for various biological and allied applications and analyze the datasets using Python and MATLAB.
Unit operations-1 (19BT3DCUO1)	CO 1 Comprehend the concepts of fluid dynamics, size reduction, filtration, sedimentation and mixing in upstream and downstream processes. CO 2 Apply physical principles governing fluid flow types, characteristics, transport systems and mechanical operations in chemical and bioprocess industries. CO 3 Identify, interpret and analyze and solve problems based on fluid flow and mechanical operations. CO 4 Work individually in exploring applications of fluid mechanics and mechanical operations in biotechnology or bioprocess and communicate the findings of the literature as oral presentations and report submission.
Seminar (19BT3DCSEM)	CO 1 Survey literature pertaining to given topic CO 2 Write effective report and present effectively by oral communication CO 3 Ability to work individually or team.
Environmental Studies (19BT4HSEVS)	CO1: Understand the components and impacts of human activities on environment. CO2: Apply the environmental concepts for conservation and protection of natural resources. CO3: Identify and establish relationship between social, economical and ethical values from environmental perspectives.
Engineering Mathematics-III (19BT3ICMAT)	CO 1 Apply Numerical techniques to solve problems arising in engineering. CO 2 Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms. CO 3 Apply the concepts of calculus to functionals.

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DEPARTMENT OF BIOTECHNOLOGY

4th semester	
Constitution of India and Professional Ethics (19HS4ICCPH)	CO1 Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land. CO2 Analyse the concepts and ideas of Human Rights. CO3 Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.
Biostatistics & probability (19MA4BSBSP)	CO 1 Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples. CO 2 Apply the basic principles of probability and Probability distributions to the problems in Engineering. CO 3 Apply the concepts of Markov chain to the field of genetics. CO 4 Demonstrate an understanding of sampling distributions and principles of experimental design.
Process Engg., Thermodynamics 919BT4ESPET)	CO-1 Comprehend the concepts of process engineering thermodynamics. CO-2 Apply the laws of thermodynamics in physical, chemical and biological systems. CO-3 Analyze the problems related to phase and reaction equilibria. CO-4 Design solution for problems related to thermodynamics for given chemical or bio process. CO-5 Review literature related to biochemical thermodynamics and analyze the problems individually.
Unit Operations-2 (19BT4DCUO2)	CO 1 Comprehend the concepts of modes of heat transfer, heat exchangers, evaporators, insulation, diffusion and separation processes. CO 2 Apply physical laws governing heat transfer and mass transfer in bioprocess operations. CO 3 Identify, interpret and analyze and solve problems based on steady state heat and mass transfer phenomena.

	CO 4 Conduct experiments on mechanical operations, momentum transfer, heat transfer and mass transfer operations. CO 5 Work individually to Identify real life problems associated with unit operations in biotechnology or bioprocess, search for solutions, and communicate the findings of the literature study and solution proposed, as oral presentations and report submission.
Cell & Molecular Biology (19BT4DCCMB)	CO 1 Understand the structure and function of bio molecules and their interactions CO 2 Compare & contrast molecular processes in bacteria & eukaryotes. CO 3 Interpret the results of molecular experiments to current and relate to the current understanding about complex process. CO 4 Apply the knowledge of molecular mechanisms to human disease states with underlying dysfunctions CO5 Use research based knowledge & methods to conduct experiments, analyze & interpret data related to cell & its processes.
Biochemistry & Bioenergetics (19BT4DCBAB)	CO 1 Understand the basic aspects of metabolic pathways of proteins, nucleic acids ,lipids, and carbohydrates CO 2 Apply the principles of thermodynamics to compute the bioenergetics of metabolic pathways in living systems CO 3 Analyze the role of key metabolic reactions and intermediates in the regulation of pathways and their mode of regulation CO 4 Analyze the changes in concentration of key intermediary metabolites under different physiological conditions CO5 Design alternative reactions in a pathway to effectively overcome a blockade in a metabolic pathway CO 6 Design, conduct experiments related to quantitative analysis of biomolecules and interpret data CO7 (open ended expts.) Engage in independent learning and work effectively as an individual to carry out literature search effectively, design, conduct experiments & interpret data and write a technical report.

Industrial handled course (19BT4DCIHC)	CO 1 Understand the importance of safety and hazard evaluation and management in industries / environment Health& safety. CO 2 Apply reasoning to access safety issues and suggest appropriate measures in industries.
Seminar Based on Summer/Winter Internship (19BT4DCSEM)	CO 1 Survey literature pertaining to given topic CO 2 Write effective report and present effectively by oral communication CO 3 Ability to work individually or team.
Community service program (19BT4NCCSP)	-

5th semester	
Bioanalytical Techniques (16 BT 5DC BAT)	CO 1. Select technique (s) that can be applied for a biomolecule separation and elucidate the principle and method CO 2. Select technique (s) that can be applied for a biomolecule purification and elucidate the principle and method. CO 3. Select and apply suitable techniques for identification of biomolecules. CO 4. Select and apply suitable techniques for characterization of biomolecules.
Bioinformatics (16 BT 5DC BIN)	CO 1. Describe various bioinformatics resources and classify biological databases and their file formats CO 2. Construct sequence alignment, analyze and interpret the data. CO 3. Perform phylogenetic analysis and interpret the data. CO 4. Perform sequence analysis, restriction site mapping, primer designing and visualization of protein structures. CO 5. Comprehend and apply the in silico tools towards drug discovery.
Reaction Engineering (16 BT 5DC REN)	CO 1. Compute chemical reactions rates using different methods. CO 2. Derive design equations for different reactors at steady state as well as analyze and solve related problems. CO 3. Estimate the residence time distributions for various non-ideal reactors and compare various models.

	CO 4. Select bioreactor for a given criteria and describe scale-up process. CO 5. Identify, interpret and solve problems related to microbial kinetics for biochemical engineering applications.
Genetic Engineering (16 BT 5DC GEN)	CO 1. Understand, Relate, compare and contrast application of various tools in gene manipulation. CO 2. Apply a suitable gene transfer methods and factors influencing its expression. CO 3. Apply a suitable approach for isolation, purification, amplification and detection of nucleic acids as well as for design and construction of a DNA/cDNA library CO 4. Apply the concepts and tools for gene manipulation in development of GMOs. CO 5. Design and conduct experiments related to gene manipulation as well as analyze and interpret data.
Immunotechnology (16 BT 5DC IMM)	CO 1. A. distinguish various types of antibody molecules and explain their production and application as therapeutics CO 1B. Draw structure of immune cells and organs, relate their role in immune defense CO 1C. Distinguish MHC class I and class II and illustrate their role in antigen processing pathways. CO 2. Describe the role of immune system in health, disease and transplant rejection CO 3. Describe various parameters in design of vaccines CO 4. Conduct experiments involving detection and quantification of antigens and antibodies
Elective-A	
Animal Biotechnology (16 BT 5DE ABT)	CO 1. Draw sketches for layouts to design cell culture labs, select and relate the usage of suitable equipment and media. CO 2. Differentiate the methods used for characterization of cultured cells. CO 3. Relate the potential applications, method of production and merits &

	demerits of transgenic technologies in health and disease CO 4. Select and describe the methodologies used for commercial scale production of animal cells and their products.
Microbial Biotechnology (16 BT 5DE MBT)	CO 1. Describe microbial growth kinetics, screening of superior producer organisms and solve related problems CO 2. Formulate bioengineering strategies large scale-production of metabolic intermediates, biopharmaceuticals, industrial biocatalysts and recombinant products CO 3. Apply the mechanism of microbial metabolism in generating energy by sustainable utilisation of biomass and organic waste CO 4. Relate the applications of microbes in Bioremediation and Bioleaching.
Human Physiology (16 BT 5DE HPH)	CO 1. Comprehend coordinated functions of various organs of human body CO 2. Recognize and explain the physiological controls and feedback loops.
Plant Biotechnology (16 BT 5DE PBT)	CO 1. Apply different methods for transformation of plants, including their specific advantages and applications CO 2. Plan ideal genetic engineering strategies for the betterment of forestry, agriculture, and for the production of novel compounds, biopharmaceuticals and bio-fuels CO 3. Adopt current regulations for the production and use of GMOs. CO 4. Use alternative cost-effective plant biotechnology methods that can replace genetic modification.
6^{TH} Semester	
Bioprocess Technology (16 BT 6DC BPT)	CO 1. Comprehend and apply the inoculum development and strain improvement techniques for a desired fermentation process.

	CO 2. Select a fermenter and formulate suitable media for a desired fermentation process. CO 3. Apply techniques and processes for batch and continuous sterilization and solve related problems. CO 4. Apply various downstream techniques for product isolation, separation and purification. CO 5. Conduct experiments for production, isolation and recovery of bio - products.
Enzyme Technology & Kinetics (16 BT 6DC ETK)	CO 1. Select appropriate methods for isolation, purification and characterization of enzymes and solve related problems CO 2. Analyze and solve problems related to kinetics of enzymatic reactions CO 3. Compare and contrast methods in enzyme catalysis and interpret the related data CO 4. Illustrate immobilization techniques and their applications CO 5. Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes CO 6. Design, conduct experiments, analyse and interpret results related to enzyme reaction kinetics
Genomics & Proteomics (16 BT 6DC GAP)	CO 1. Select and describe techniques and approaches for genome sequencing. Analyze and interpret related data CO 2. Select and describe applications of various contemporary genome mapping techniques as well as interpret related data CO 3. Select and describe applications of contemporary high-throughput techniques for analysis of genomes, transcriptomes and Proteomes. CO 4. Differentiate the application of contemporary high-throughput techniques for proteinprotein interaction studies
Pharmaceutical Biotechnology (16 BT 6DC PBT)	CO 1. Outline the drug development process, its economics and regulatory guidelines.

	CO 2. Describe the concepts of tablet manufacturing, formulation, dosage forms and modes of drug delivery CO 3. Distinguish different phases of drug and toxicants metabolism as well as apply concepts of pharmacokinetics and pharmacodynamics in drug development process. CO 4. Relate application of biopharmaceuticals for different therapeutic conditions.
Process Control and Automation (16 BT 6DCPCA)	CO 1. Classify automatic process control systems and solve problems related to Laplace Transform CO 2. Deduce transfer function for various systems as well as analyze and interpret the responses CO 3. Comprehend the working principle of various controllers, final control elements and solve related problems CO 4. Analyze the stability of system using different tools and techniques CO 5. Measure and control the various physical parameters using controllers
Elective-B	
Metabolic Engineering (16 BT 6DE MTE)	CO 1. Elucidate central metabolic reactions and models used for cellular reactions. CO 2. Comprehend regulation of metabolic pathways at different levels and analyze metabolic flux for real time applications CO 3. Describe the metabolic control analysis and plan a suitable metabolic design for maximizing product yield. CO 4. Relate applications of metabolic engineering for current research/industrial practices
Bioinstrumentation & Biosensors (16 BT 6DE BIB)	CO 1. Describe components and applications of biomedical devices CO 2. Select and describe usage & working principle of biomedical devices for cardiovascular and respiratory system measurements

	CO 3. Apply the concepts in design of a biosensor to detect analytes
Genome Informatics (16 BT 6DE GIN)	CO 1. Comprehend and compare various Next-Generation Sequencing Techniques CO 2. Comprehend and apply the tools for assembly of Sequencing Data. CO 3. Illustrate applications of different algorithms used to acquire, analyse, assemble and visualize the genomic sequence data. CO 4. Relate the application of NGS in diagnosis and treatment of diseases.
Food Biotechnology (16 BT 6DE FBT)	CO 1. Comprehend the physico-chemical characteristics of foods CO 2. Apply biotechnological procedures in food industry. CO 3. Apply various methods for identification of microbes in food. CO 4. Identify suitable techniques for preservation of food.
7th Semester	
Bioprocess Equipment Design and CAED (16BT7DC EQD)	CO 1. Comprehend the importance of parameters required to design process equipment CO 2. Identify the various symbols used in process flow diagrams CO 3. Draw the sketches of pipe joints, stuffing box, valves, pumps and bioprocess vessels using CAED CO 4. Design shell & tube heat exchanger, distillation column and Fermenter for given parameters
Process Plant design & Economics(16BT7DC PPE)	CO 1. Select suitable site, plant lay out and technologies required for establishment of a process plant CO 2. Emphasize on the role of process engineer and check the feasibility of process CO 3. Estimate the cash flow in industrial operations and depreciation charges CO 4. Select suitable process by estimating the production cost and profitability analysis

Bioethics, Biosafety and IPR (16BT7DC BIP)	CO 1. Understand the basic structure of intellectual property and its relevance to modern biotechnology CO 2. Adoption of patenting system in day-today research for protecting innovative ideas as well as the age-old traditional skills CO 3. Inculcate ethics and understand the possible societal anticipations of outcomes from potential applications of biotechnology targeting the end-user CO 4. Learn and adopt the established guidelines with respect to biosafety practices in research and development sectors
Mini project (16BT7DC MPR)	CO 1. Comprehend a given problem pertaining to BT CO 2. Compile, analyse and interpret data from the literature collected and derive valid conclusion CO 3. Design and conduct preliminary experiments independently toward standardization of protocols within a given period of time. CO 4. Write effective report and Communicate effectively by oral presentation
Biotechnology for society (16BT7DC BFS)	CO 1. Comprehend the role and impact of Biotechnology on the society. CO 2. Understand the responsibility of biotechnologist towards society
Elective-C	
Industrial Biotechnology (16BT7DE IBT)	CO 1. Understand the concept of bioconversion and media design. CO 2. Identify and analyze the metabolic pathways involved in production of different metabolites from living organisms. CO 3. Distinguish and apply the process technologies for large scale production of industrially important products from living organisms
Aqua & Marine BT (16BT7DE AMT)	CO 1. Understand the biology of marine micro-macro flora and fauna. CO 2.Apply

	the techniques for detection of marine organism and bio-augmentation CO 3. Comprehend on the marine food processing, product and safety. CO 4. Screening & purification of bioactive compounds from marine flora & fauna
Biomaterials & Tissue Engineering (16BT7DE BTE)	CO 1. Compare and distinguish various biomaterials CO 2. Justify the use of suitable biomaterials for various applications CO 3. Understand the role of implants in artificial organs CO 4. Identify the suitable use of implants in tissue replacement
Clinical Data Management (16BT7DE CDM)	CO 1. Apply principle steps in drug discovery CO 2. Outline the pertinent issues involved in undertaking of clinical research and recruitment of subjects for study CO 3. Distinguish the roles of CRC, CRA for effective data management in clinical research.
8th semester	
Project management and Finance (HSS Core) (16BT8DC PMF)	CO 1. Identify the characteristics of project and role of project manager. CO 2. Check the feasibility of project and categorize its life cycle CO 3. Apply scheduling and financing techniques for given project CO 4. Develop cost control strategies for project CO 5. Communicate with team and measure the performance of project
Project work (16BT8DC PRW)	CO 1. Identify the problem and survey literature pertaining to the problem. CO 2. Explore for sustainable solutions and reason the impact of BT solutions to the problem chosen. CO 3. Understand the need for good experimental design and scientific research practices CO 4. Select an appropriate protocol and conduct the experiments CO 5. Analyse, interpret data and derive valid conclusions.

	CO 6. Write effective report and Communicate scientifically via oral presentation. CO 7. Execute the project in team within stipulated time period.
Internship/Industrial Training/ technical seminar(16BT8DC IRS)	CO 1. Survey literature pertaining to given problem CO 2. Formulate the problem, plan and conduct experiment in a given time period CO 3. Apply various BT techniques to derive a valid conclusion CO 4. Write effective report and present effectively by oral communication CO 5. Ability to work individually or team
Management & Entrepreneurship (**16HS8DCMME**)	CO 1. Comprehend the various functions and approaches of management and entrepreneurship. CO 2. Apply knowledge of management, entrepreneurial skills and financial support in solving issues of an industry or Start-ups at various levels. CO 3. Able to design solutions using principles and attributes of management for an industry for a given case or situation. CO 4. Demonstrate managerial skill by prepare business plan for a given project and able to communicate.
Elective D	
Transport Phenomena (16 BT8DETRP)	CO1. Comprehend one dimensional transport process and its applications in laminar flow and turbulent conditions CO2 Identify and Analyze transport process involved in molecular motion. CO3 Derive and apply equations for solving momentum, mass and heat transfer problems
Nano-Biotechnology (16 BT8DE NBT)	CO 1. Identify the Nano biomaterials and understand their properties. CO 2. Apply the concepts of nanotechnology for Nano analytics and characterize nanomaterial. CO 3. Comprehend the concept of nanotechnology and their role in a wide range of diagnostic and therapeutic applications

Data Analytics (16 BT8DE DAN)	CO 1. Comprehend the basics of Hadoop, Hive and RHADOOP CO 2. Apply HADOOP and RHADOOP to analyse the data CO 3. Design big data applications schema and use HIVE QL to analyse the data.
Advanced Programming (16 BT8DE APG)	CO 1. Comprehend the basics of R programming and Bioconductor CO 2. Apply statistical techniques using R Programming for analysis of data. CO 3. Analyze and interpret the Biological data using the Bioconductor tools
Open electives 7th semester	
Instrumental Methods of Analysis (16BT7IE IMA)	CO1. Ability to understand and remember the principles and applications of various techniques used in the purification and analysis of biomolecules. CO 2. Ability to select and apply appropriate tools and techniques in the purification and analysis of biomolecules. CO 3. Ability to critically analyze different techniques used for the purification and analysis of biomolecules. CO 4. Ability to design solution to problems by applying suitable components of bio-analytical techniques. CO 5. Ability to work individually and as a team in a multidisciplinary environment.
Ecology and Environmental Management (16BT7IE EEM)	CO 1. Understand key ecological concepts and the ecological interactions which effect environment CO 2. Analyze and predict the effects of ecological interactions amongst populations. CO 3. Understand the phytogeographical and zoogeographical distribution of the world. CO 4. Understand the principles and concepts related to environmental management. CO 5. Analyze and evaluate the applicability of various biotechnological principles for

	maintenance of ecological sustainability. CO 6. Understand the guidelines and regulatory policies involved in environmental management.
Open electives 8th semester	
Research Methodology (16 BT IE RMD)	CO1. Understand how scientific research is conducted. CO2. Design methodology for research. CO3. Comprehend the methods and techniques involved in Data collection CO4. Apply the basic statistics to test the significance, validity and reliability of the research results. CO5. Interpret the research results and prepare report.
Forensic Science (16BT8IEFRS)	CO1.Comprehend on views of forensic procedure and protocols required to solve cases CO2. Describe the organization of crime lab and processing of crime scene based on evidences CO3. Summarize various types of evidences and methods of analyzing the evidences CO4. Explain categories of cybercrime and ethics involved in Forensic sciences

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DEPARTMENT OF AEROSPACE ENGINEERING

Academic Year 2019-20

Name of the Program	B.E. in Aerospace Engineering
Program Specific Outcomes (PSOs)	PSO 1: Apply their subject knowledge in the domain of Aerodynamics, Flight mechanics, Avionic systems and Propulsion to solve real world problems utilizing advanced technology. PSO 2: Develop new ideas in the field of aerospace engineering and maintenance practices with the knowledge of mechanics, materials, manufacturing and maintenance along with the help of modern CAD/CAM/CAE tools.
Program Outcomes(POs)	PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations. PO6: 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. PO7: 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. PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as member and leader in a team, to manage projects and in multidisciplinary environments. PO12: 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.

Course Names	**Course Outcomes (COs)**	
3rd & 4th Semester		
Introduction to Aerospace Engineering (19AE3DCIAE)	CO-1	Understand the general concepts and problems of aerospace engineering.
	CO-2	Understand the disciplines and sub groups in aerospace engineering.
	CO-3	Illustrate the global and Indian aerospace activities and future challenges
Aero - Thermodynamics (19AE3DCATD)	CO-1	Understand the thermodynamic laws and their applications
	CO-2	Familiarize with gas power cycles, gas mixture and chemical reactions
	CO-3	Appreciate the need for studying the aero-thermodynamics.

Aero – Fluid Mechanics (19AE3DCAFM)	CO-1	Understand the concepts of fluid behavior and their properties.
	CO-2	Familiarize with flow through closed conduits and gas flow behavior
	CO-3	Apply the dimensional analysis to fluid flow problems
	CO-4	Analyze the conservation laws of fluid flow
	CO-5	Apply and solve fluid problems in aerospace engineering.
Materials for Aerospace Engineering (19AE3DCMAE)	CO-1	Classify the different materials and their properties.
	CO-2	Understand the characteristics and applications of these materials in aerospace industry
	CO-3	Interpret the behavior and characterization of Ceramics, composites and stealth materials
Manufacturing Technology for Aerospace Engineering (19AE3DCMTA)	CO-1	Distinguish clearly between primary, secondary and advanced manufacturing processes.
	CO-2	Explain the mechanical working of metals along with machining and surface finishing processes.
	CO-3	Understand the NC machining and RP based manufacturing processes.
	CO-4	Summarize the gear-manufacturing processes and aero engine manufacturing process.
Computer Aided Tools for Aerospace Engineering (19AE3DCCTA)	CO-1	Understand the computer tools, their need and salient features.
	CO-2	Select the most appropriate tools for aerospace applications.
	CO-3	Utilize the specific computation tools for aerospace problem solving and analysis.
Aircraft Systems, Avionics and Instrumentation (19AE4DCAAI)	CO1	Explain the importance subsystems and environmental specifications of Avionics Systems.
	CO2	Derive air data laws and explain its use in air data computer.
	CO3	Explain basic elements of electronics and communication systems and its applicability to radio navigational aids.
	CO4	Understand the working principle of inertial sensors like gyros and accelerometers and its use in inertial navigation systems.

	CO5	Make use of basic principle of Autopilot and UAV systems.
Aero – Heat and Mass Transfer (19AE4DCAHT)	CO-1	Familiarize with the various modes of heat transfer
	CO-2	Solve the heat transfer problem related to aerospace engineering.
	CO-3	Understand the Mass transfer concepts related to aerospace engineering.
Basic Aerodynamics (19AE4DCBAD)	CO-1	Estimate the pressure distribution acting on an airfoil and the wing geometry subjected to incompressible inviscid flow condition using respective theories.
	CO-2	Determine the aerodynamic performance characteristics of various aerodynamic bodies using experimental measurement techniques.
	CO-3	Justify the role of fundamental potential flows in assessing the aerodynamic behavior of lifting and non-lifting bodies.
	CO-4	Summarize the aerodynamic interaction effects between a propeller and different components of the aircraft.
Aero-Solid Mechanics (19AE4DCASM)	CO-1	Understand the concepts of stress and strain.
	CO-2	Analyse the concepts in structural elements like bars, shafts and columns for loading.
	CO-3	Analyze the beams of different cross sections for shear force, bending moment, slope and deflection.
	CO-4	Understand the concepts of employing energy methods to solve physical problems.
Aerospace drawing and drafting (19AE4DCADD)	CO-1	Identify the machine elements and aerospace components by their symbols and notations.
	CO-2	Model the aerospace vehicle components and assembly drawings.
	CO-3	Understand the various forms of mechanical joints.

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DEPARTMENT OF MANAGEMENT STUDIES AND RESEARCH CENTRE

Academic Year 2019-20

Name of the Programme	**Department of Management Studies and Research Centre**
Programme Specific Outcomes (PSOs)	1. Graduating students will have a holistic knowledge, required skills and attitudes that demonstrate ability to perform as management professionals 2. Graduates will exhibit the ability to solve problems in the real world that need cross functional team work 3. Graduates will be effective management leaders of time, to deliver desired results.
Programme Outcomes (POs)	**PO1.** Apply knowledge of management theories and practices to solve business problems. **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, communicate global, economic, legal, and ethical aspects of business. **PO5.** Ability to lead themselves and others in the achievement of organizational goals, contributing effectively to the team environment. **PO6.** Ability to develop entrepreneurial thinking and business acumen. **PO7.** Ability to foster research skills and their applications in the respective domain.
Course Outcomes (COs) – 1st Sem	
1. MANAGEMENT PROCESS AND ORGANIZATIONAL BEHAVIOUR - 18MBA1PCMO	CO1-Learn and apply techniques in General Management and Organization Behaviour to solve business problems
	CO2-Analyze and assess facets of Business environment for various Organizational purposes
	CO3-Nurture leadership skills required to manage the team effectively, in order to achieve Organization's objectives
	CO4-Inculcate critical thinking skills in students to enable them to analyze business data and cases and make decisions related to General Management and Organization Behaviour
	CO5-Develop value based leadership through oral presentation and assignments
2. MANAGERIAL ECONOMICS - 18MBA1PCME	CO1-Learn and apply the principles and practices of microeconomics to solve business

	problems.
	CO2-Understand and analyse the demand, cost, production, pricing, profit and capital management aspects of business.
	CO3-Think, analyse, assess, summarise and present (oral and written) using cases and data for decision making.
	CO4-Formulate competitive strategies to bring in entrepreneurial thinking and business acumen.
3. ACCOUNTING FOR MANAGERS - 18MBA1PCAC	CO1-Understand the accounting cycle.
	CO2-Apply the effect of business transactions on organizations' accounting records.
	CO3-Analyze the accounting system to prepare financial statements and to interpret them.
	CO4-Communicate accounting Concepts, principles, Indian / International framework to variety of audience.
4. MARKETING MANAGEMENT - 18MBA1PCMM	CO1-Understand & apply marketing concepts to solve marketing problems
	CO2-Analyze & evaluate the marketing mix of a product or a service
	CO3-Ability to create an Integrated Marketing Communications plan for an organization
	CO4-Create & present a marketing plan for a given entity.
5. BUSINESS COMMUNICATION - 18MBA1PCBC	CO1-Understand the principles of communication required for working with internal teams and external stakeholders.
	CO2-Apply the skills of oral communication and written communication to enhance interpersonal relationships and leadership ability.
	CO3-Analyse the situation and apply the appropriate communication strategy and systems.
	CO4-Ability to gain critical thinking skills by evaluating communication requirements.
6. BUSINESS ANALYTICS - 18MBA1PCBA	CO1-Apply Business Analytics concepts in various business domains
	CO2-Evaluate descriptive statistics, probability and conduct hypothesis testing in business context.
	CO3-Develop predictive analytical models
	CO4-Comprehend some common approaches used in data mining and also understand the scope of prescriptive analytical models

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DEPARTMENT OF MANAGEMENT STUDIES AND RESEARCH CENTRE

Course Outcomes (COs) – 2nd Sem	
1. OPERATIONS RESEARCH - 18MBA2PCOR	CO1-Understand the nature of Operations Research.
	CO2-Develop the mathematical models of Operations Research to solve business problems.
	CO3-Use the analytical models for making business decisions using Operations Research techniques.
	CO4-Communicate the results of quantitative analysis to various aspects of business.
2. FINANCIAL MANAGEMENT - 18MBA2PCFM	CO1-Understand the basics of financial environment
	CO2-Imbibe the knowledge of financial management theories and practices to solve business problems
	CO3-Develop analytical and critical thinking skills of financial decisions by associating tools and techniques for data based decision
	CO4-Communicate the various aspects of financial management.
3. HUMAN RESOURCE MANAGEMENT - 18MBA2PCHR	CO1-Understand and apply the fundamental concepts in People Management
	CO2-Analyse the business situation and utilize the people management skills
	CO3-Develop critical thinking skills to make decisions involving people
	CO4-Gain knowledge on Industrial Relations to handle people related issues
4. BUSINESS RESEARCH METHODS - 18MBA2PCBR	CO1-Understand the steps needed to complete a research study and formulate a research design
	CO2-Apply various data collection methods for research in different business domains
	CO3-Analyse data using various tools and techniques for decision making
	CO4-Create effective business reports and do presentations
5. BUSINESS, GOVERNMENT AND SOCIETY - 18MBA2PCBG	CO1-Comprehend the elements of business, government and society and their interrelationship.
	CO2-Apply the knowledge of BGS to solve the business problem.
	CO3-Analyze and present the interaction among business, government and a society based on qualitative data.
	CO4-Discern and analyze the legal and ethical aspects of the business.

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DEPARTMENT OF MANAGEMENT STUDIES AND RESEARCH CENTRE

6. MANAGEMENT INFORMATION SYSTEM - 18MBA2PCMS	CO1-Understand the role of Information Technology in Management
	CO2-Apply IT Solutions for Business Problem Solving
	CO3-Relate to the usage of Internet and its role in managing a business
	CO4-Analyse the impact of IT on society
Course Outcomes (COs) – 3rd Sem	**CORE PAPER**
1. OPERATIONS MANAGEMENT - 18MBA3PCOM	CO1-Apply various aspects of operations management to solve business problems
	CO2-Make data driven decision in the domain of Operations Management
	CO3-Analyse operation processes from different perspectives such as forecasting productivity, workflow, quality and break even.
	CO4-Use and communicate concepts of Operations management for organisational effectiveness through oral presentations and written reports.
2. MACRO BUSINESS ENVIRONMENT - 18MBA3PCMB	CO1-Apply the concepts of Macro Economics to solve business problems.
	CO2-Analyze and Communicate the Macro Environment of Global, economic, legal and ethical aspects of business. economy to foster critical thinking for developing solutions to address the gaps.
	CO3-Adopt the policies for various sector to develop Entrepreneurial thinking and business acumen.
	CO4-Assess the status of infrastructure and human resources in the Indian
3. ENTREPRENEUR SHIP DEVELOPMENT - 18MBA3PCED	CO1-Apply the competencies of entrepreneurs in real time
	CO2-Evaluate a business opportunity, recognize the sources of various funding and create a business plan
	CO3-Analyse and interpret different Government schemes
	CO4-Decipher the intricacies of family business and Social Enterprise
HR SPECIALIZATION -FUNCTIONAL ELECTIVES	
1. RECRUITMENT & SELECTION-18MBA3FHRS	CO1-Apply the key concepts of recruitment and selection to evaluate applicants fairly and in an unbiased manner
	CO2-Critically think in adopting appropriate

	tools for evaluating recruitment and selection methods
	CO3-Analyze the importance of Recruitment and selection thus enabling them to design recruitment advertisement
	CO4-Deploy right person to the right position thus helping in accomplishing the aims of organization
	CO5-To nurture research skills in Recruitment and selection through assignments and presentations.
2.COMPENSATION MANAGEMENT - 18MBA3FHCM	CO1-Understand the concepts of compensation system followed in the organisation
	CO2-Analyse the economic, legal, strategic and ethical aspects of pay systems in any industry and organizations
	CO3-Design a compensation package for employees of different level and sectors
	CO4-Analyse the role of government and taxation process related to compensation
3. LEGAL ENVIRONMENT & INDUSTRIAL LEGISLATIONS - 18MBA3FHLI	CO1-Understand the Indian Legal and Regulatory Environment and learn to apply the appropriate labour laws to protect the interest of both employees and employers
	CO2-Cultivate value based leadership capabilities to drive business
	CO3-Develop critical thinking skills to ensure justice to the different stake holders
	CO4-Assess the legal and ethical implications on business and present the same, orally and through assignments
4. ORGANIZATION STRUCTURE, PROCESS & DESIGN - 18MBA3FHOS	CO1-Study the logic behind developing Management techniques and Practices so that it can be applied in various business scenarios
	CO2-Develop value based leadership capabilities necessary to improve Organizational Effectiveness
	CO3-Develop critical thinking skills to help them make appropriate business decisions
	CO4-Analyse the business situation and use the appropriate management techniques
5. KNOWLEDGE MANAGEMENT - 18MBA3FHK M	CO1-Understand the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management
	CO2-Apply KM cycles and tools for the advantage of organization functioning

	CO3-Critically evaluate the KM practices across different sectors
	CO4-Create communities of practice for KM sharing through a common platform
6. EMPLOYEE RETENTION MANAGEMENT - 18MBA3FHER	CO1-Understand the causes of employee attrition and apply skills to assess if attrition is controllable or uncontrollable
	CO2-Critically analyse the business environment and take appropriate action to manage the situation
	CO3-Develop critical thinking skills and adopt appropriate practices to reduce attrition
	CO4-Design employee retention strategies based on the prevailing situation in the Organisation
HR SPECIALISATION:	**CROSS FUNCTIONAL ELECTIVES**
1. ORGANIZATIONAL LEADERSHIP AND TEAM BUILDING - 18MBA3XHOL	CO1-Understand the dynamics and behaviours of leaders and the team members.
	CO2-Foster learning teams in organizations
	CO3-Analyse tools and techniques of leading teams.
	CO4-Analyse different leadership styles and their application in business situations
2. PUBLIC RELATIONS - 18MBA3XHPR	CO1-Define and understand the role of PR for effectiveness and long term Sustainability of the organization
	CO2-Apply the methods of PR for solving the business issues
	CO3-Employ different techniques and approaches to maintain good relationship with different external stake holders.
	CO4-Analyse situations and know how to communicate to all the stake holders during a crisis
MARKETING SPECIALIZATION	**FUNCTIONAL ELECTIVES**
1. CONSUMER BEHAVIOUR - 18MBA3FMCB	CO1-Apply Knowledge of consumer behavior principles, theories, concepts and techniques to solve business problems
	CO2-Classify the different consumer behaviour and their impact on purchasing decisions
	CO3-Propose the effectiveness of various advertisement and promotions and their attempts to influence the behaviours of individuals across various aspects of business
	CO4-Asses the consumer buying behavior with

	the help of a course project/ assignment as a team
2. BUSINESS MARKETING - 18MBA3FMBM	CO1-Understand the theory & apply the concepts of B2B markets.
	CO2-Analyse the purchase situation of an organization and associated interpersonal relationships.
	CO3-Analyse the marketing mix of a B2B entity.
	CO4-Present a report on the business marketing scenario of an organization in industrial market.
3. MARKETING RESEARCH - 18MBA3FMMR	CO1-Apply knowledge of marketing research principles in conducting exploratory research to define the research problem of a business.
	CO2-Interpret and conduct a small survey, applying a wide range of scale, and questionnaire techniques to analyze business aspects.
	CO3-Recommend the best sampling technique for different situations and defend that recommendation to foster research skills.
	CO4-Create a frequency distribution and a cross-tabulation, conduct basic statistical analysis on the data, and summarize the results in clear language for data based decision making
4. SERVICES MARKETING - 18MBA3FMSM	CO1-Understand the theory & apply the concepts of Service Marketing.
	CO2-Analyse the various GAPs in services using a GAP model and various ways to solve them.
	CO3-Evaluate the importance of Service triangle and the role played by in services.
	CO4-Present a SERVQUAL report for a service.
5. MARKETING METRICS - 18MBA3FMMM	CO1-Apply the knowledge of marketing metrics practices to solve business problems.
	CO2-Foster marketing metrics to functional and organizational strategy with data based decision making.
	CO3-Define key metrics related to consumers, markets, branding and finance to understand and analyze global, economic aspects of business
	CO4-Ability to create marketing metrics dashboard and identify metrics suitable for achievement of organizational goals.
6. PRODUCT MANAGEMENT-18MBA3FMPM	CO1-Apply the knowledge of product management concepts, theories to solve business problems.

	CO2-Use portfolio analysis and the product life cycle to understand how a firm manages its product mix for decision making.
	CO3-Apply and understanding the role of product manager in pricing, sales, and promotion in the aspects of business.
	CO4-Devise new product development process which in turn develops entrepreneurial thinking and business acumen through a team based course project
MARKETING SPECIALISATION	**CROSS FUNCTIONAL ELECTIVES**
1. SALES MANAGEMENT - 18MBA3XMSM	CO1-Apply the concepts of Sales Management in business and summarize the selling skills and sales process
	CO2-Apply Selling strategies and adopt the best solution to a given business problem
	CO3-Compare the different recruitment and compensation strategies
	CO4-Building sales plan and critique the same for any organization
2. EVENT MARKETING & MANAGEMENT - 18MBA3XMEM	CO1-Describe the importance and understand the marketing strategies of Event Marketing
	CO2-Apply Internet to Event Marketing and develop strategies
	CO3-Explore the different sources of funding for Events, critique the different options and adopt the best feasible event to the requirement of the business
	CO4-Effectively plan and defend Event Marketing Programs for any type of business
FINANCIAL MANAGEMENT SPECIALIZATION	**Functional Electives**
1. ADVANCED FINANCIAL MANAGEMENT - 18MBA3FFAF	CO1-Apply various financial management decisions in their business.
	CO2-Analyze risks involved and thereby assess optimal capital structure and dividends in various project decisions.
	CO3-Understand various contemporary issues in managing business/sick units
	CO4-Develop research skills in the area of financial management.
2. INVESTMENT MANAGEMENT - 18MBA3FFIM	CO1-Understand the capital market and various Instruments for Investment.
	CO2-Assess the risk and return associated with investments and value securities.

	CO3-Analyze the Economy, Industry and Company framework for Investment Management.
	CO4-Learn the theories of Portfolio management and also the tools and techniques for efficient portfolio management.
3. Financial Reporting - 18MBA3FFFR	CO 1-Students shall understand various dimensions of financial reporting.
	CO 2-Students shall apply the knowledge of financial reporting to prepare various financial statements.
	CO 3-Develop critical thinking skills to analyze the financial soundness of the business.
	CO 4-Students shall communicate International accounting standards and contemporary issues in Accounting.
4. RISK MANAGEMENT & INSURANCE - 18MBA3FFRI	CO1-Identify and measure Individual and Business risk
	CO2-Evaluate Life Insurance subscription decisions
	CO3-Analyze and compare General Insurance products
	CO4-Research on the functioning and pricing of insurance companies
5. MICRO FINANCE - 18MBA3FFMF	CO1-Understand of role of Microfinance in addressing the problem of poverty and income generating activities to the poor people.
	CO2-To appreciate the Financial Institution's and NGOs as partners in socioeconomic development process of the poor.
	CO3-To develop leadership skills by tackling complex social issues from a policy perspective.
	CO4-To analyze the various reasons for the existence of MFIs, and the challenges MFI.
6. MERCHANT BANKING& FINANCIAL SERVICES - 18MBA3FFMB	CO1: Understand the Indian Financial System.
	CO2: Assess the nature of services offered by Merchant bankers in India.
	CO3: Examine various services offered by NBFCs.
	CO4: Evaluate various financial services for decision making.
FINANCIAL MANAGEMENT ELECTIVES	**CROSS FUNCTIONAL ELECTIVES**
1. VENTURE CAPITAL FINANCING - 18MBA3 XFVC	CO1-Identify various sources of financing for a firm including Venture capital
	CO2-Analyze the appropriate venture funding

	requirement in the right phase of business
	CO3-Create and interpret term sheets for venture capital financing and do due diligence
	CO4-Research and do Valuation of a company and use it to negotiate a venture capital investment
2. PRINCIPLES & PRACTICE OF BANKING - 18MBA3XFPB	CO1-Apply knowledge of Principles and Practice of banking in banking operations.
	CO2-Develop the ability to manage operations of banking.
	CO3-Analyze various current and changing scenario of Indian banking sector with respect to structure, customer relationship , regulation, banking technology and international banking
	CO4-Identify and assess the impact of development in the literature on banking sector
Course Outcomes (COs) – 4th Sem	**CORE PAPER**
1. STRATEGIC MANAGEMENT - 18MBA4PCSM	CO1-Apply knowledge of strategic management theories and concepts to solve business problems
	CO2-Ability to foster critical thinking abilities for decision making with the use of case studies
	CO3-Ability to appreciate and develop value based leadership
	CO4-Ability to understand, analyse and communicate global, economic and ethical aspects of business using business strategies
	CO5-Lead themselves and others in achievement of organizational goals and contributing to the team environment through presentations.
HUMAN RESOURCES MANAGEMENT	**FUNCTIONAL ELECTIVES**
1. LEARNING & DEVELOPMENT - 18MBA4FHLD	CO1-Understand the concepts related to Training and development in the organization.
	CO2-Design a training environment which can maximize learning in the organization.
	CO3-Analyse and evaluate the economic and strategic aspects of training programs
	CO4-Develop Leadership ability through employee development and career management.
2. STRATEGIC TALENT MANAGEMENT -	CO1-Understand the concepts related to talent

18MBA4FHST	management in the organization.
	CO2-Apply the competency mapping to solve business problems
	CO3-Apply performance management theories and practices to solve organization problems
	CO4-Analyse the economic, legal, strategic and ethical aspects of performance management system
3. ORGANIZATIONAL DEVELOPMENT - 18MBA4F HOD	CO1-Understand the concepts related to Change Management and apply it in various business scenarios
	CO2-Develop value based leadership capabilities to drive change in an Organization to improve effectiveness.
	CO3-Inculcate critical thinking skills to make appropriate Change Management decisions
	CO4-Analyze the business situation where change is necessitated and recommend the necessary action
4. INTERNATIONAL HUMAN RESOURCE MANAGEMENT - 18MBA4FHIH	CO1-Apply the strategies of IHRM in business organizations/specific functional areas
	CO2-Analyse the differences between domestic and International HR activities.
	CO3-Identify and analyse social, cultural and global issues around IHRM
	CO4-Deliver presentations and seminars by distinguishing the features of IHRM across different countries.
5. MANAGERIAL COUNSELING - 18MBA4FHMC	CO1-Understand the significance of counselling and counsellors at work place
	CO2-Apply techniques of counselling in real organizational problems
	CO3-Analyse problems for counselling, thus employ effective communication styles
	CO4-Identify and evaluate ethical standards in the process of counselling
6. HR ANALYTICS - 18MBA4FHHA	CO1-Understand the prominence of numbers in HRM
	CO2-Apply statistical tools for business outcomes in HR analytics
	CO3-Analyse the outcomes of HR analytics and

	assist the decision making process
	CO4-Apply SPSS for different cases of HR analytics.
HUMAN RESOURCES MANAGEMENT	**CROSS FUNCTIONAL ELECTIVES**
1. PERSONAL GROWTH & INTERPERSONAL EFFECTIVENESS - 18MBA4XHPG	CO1-Identify and understand the strengths and weaknesses as individual, as a member of a group/organization using personality typing and personality theories
	CO2-Apply habits of personal effectiveness to be a better leader
	CO3-Critically thinking and use appropriate tools and communicate for better interpersonal relations
	CO4-Design transactions and scripts to make the effective organizational team
2. WORK ETHICS - 18MBA4XHWE	CO1-Understand the meaning of good ethics, doing things right and the obstacles to making good ethical decisions
	CO2-Identify ethical issues in human resource management
	CO3-Critically think and identify privacy issues in workplace
	CO4-Design a code of conduct for business organization.
MARKETING MANAGEMENT	**FUNCTIONAL ELECTIVES**
1. RURAL MARKETING - 18MBA4FMRM	CO1-Apply knowledge of rural marketing principles, theories, concepts and techniques to solve rural business problems.
	CO2-Analyze the consumer behavior in the rural areas through research.
	CO3-Assess the marketing of Agri Input and output and develop entrepreneurial thinking.
	CO4-Analyze, apply the concepts to design, distribution, communication strategy and marketing plan in rural area.
2. MARKETING CHANNEL MANAGEMENT - 18MBA4FMCM	CO1-Apply the knowledge and practices that involved with the development of channel structure, the management of intermediary, and the coordination among channel members to solve business problems.

	CO2-Appreciate the strategic value of managing a portfolio of distributors effectively for aspects of business
	CO3-Classify the strengths and weaknesses of various channels and partnerships for decision making
	CO4-Lead themselves and others to develop strategic implications of marketing channels related to other marketing mix with case studies/ assignments.
3. INTEGRATED MARKETING COMMUNICATIONS - 18MBA4FMIC	CO1-Apply knowledge of marketing communication theories and practices to solve marketing communication problems.
	CO2-Understand, analyse, communicate global, economic, legal, and ethical aspects of business
	CO3-Lead themselves and others in the achievement of marketing communication goals.
	CO4-Create a video ad for a product/service.
4. RETAIL MANAGEMENT - 18MBA4FMRE	CO1-Apply the concepts of retailing into business practices
	CO2-develop critical & logical thinking with the help of case studies and articles
	CO3-Evaluate the various strategies adopted by the retailers and make an informed choice.
	CO4-Assess the theoretical applications in retail outlets through a team based course project and submit a formal report.
5. INTERNATIONAL MARKETING - 18MBA4FMIM	CO1-Develop an understanding of the major issues related to International Marketing
	CO2-Develop skills in researching and analyzing trends in global markets and in modern marketing practice
	CO3-Assess, plan and critique an organization's ability to enter and compete in international markets.
	CO4-Devise and Judge strategies for International marketing scenarios from India's point of view
6. STRATEGIC MARKETING - 18MBA4FMSM	CO1-Apply knowledge and theories of marketing strategy to solve business problems.
	CO2-Appreciate the differences in marketing environment and changes in strategy to enable critical thinking abilities for decision making using case studies
	CO3-Understand the role of marketing information systems in building marketing strategies to achieve organizational goals

	CO4-Build a marketing plan& develop entrepreneurial thinking with the help of a course based project/ assignment
MARKETING MANAGEMENT	**CROSS FUNCTIONAL ELECTIVES**
1. STRATEGIC BRAND MANAGEMENT - 18MBA4XMBM	CO1-Apply the knowledge of principles, concepts, and models of branding to solve business problems
	CO2-Grasp the significance of brand management with other marketing decision making process
	CO3-Assess the issues related to developing and maintaining brand values with global, legal and ethical aspects of business.
	CO4-Create a brand including positioning and marketing communication with a team based course project
2. E-MARKETING - 18MBA4XMEM	CO1-Apply knowledge of E-marketing theories and practices to solve business problems
	CO2-Foster Analytical and critical thinking abilities for data based decision making
	CO3-Understand, analyse, communicate global, economic, legal, and ethical aspects of E-marketing
	CO4-Create a website with provided parameters
FINANCIAL MANAGEMENT	**FUNCTIONAL ELECTIVES**
1. MERGERS, ACQUISITIONS AND CORPORATE RESTRUCTURING - 18MBA4FFMA	CO1-Assess the value creation of various corporate restructuring activities
	CO2-Analyze M&A transactions and deal financing
	CO3-Research and Valuation of a company pre and post M&A activity
	CO4-Comprehend the legal issues in M&A's
2. DERIVATIVES - 18MBA4FFDR	CO1-Apply knowledge of derivatives to solve business problems in financial risk
	CO2-Demonstrate an understanding of the use of financial engineering and risk management approaches and techniques used in modern organizations.
	CO3-Make informed judgements on the use of derivative instruments
	CO4-Identify and assess the impact of development in the literature on derivatives through research.
3. STRATEGIC CREDIT MANAGEMENT -	CO1-Apply the concept of credit management

18MBA4FFSC	keeping in banking operations
	CO2-Develop analytical skills for lending decisions.
	CO3-Analyse various financing schemes related to agriculture, retail loans and SMEs.
	CO4-Identify and assess the impact of development in the literature on credit Management
4. INTERNATIONAL FINANCIAL MANAGEMENT - 18MBA4FFIF	CO1-Understand the International Financial System Foreign Exchange market and its components.
	CO2-Apply the theories of International Finance in Business.
	CO3-Foster analytical thinking on derivative trading strategies in foreign exchange risk management
	CO4-Evaluate and assess the Firm's Exposure to risk in International environment using problems and cases.
5. TAX MANAGEMENT - 18MBA4FFTM	CO1-Understand the provisions of tax assessment in Indian Scenario.
	CO2-Apply their knowledge in assessing tax liability of an Individual.
	CO3-Analyze and evaluate the information for the calculation of the taxable income of a business or profession or a firm.
	CO4-Communicate effectively the Indian Income Tax Information.
6. PROJECT APPRAISAL, PLANNING & CONTROL - 18MBA4FFPA	CO1: Develop project plans and appraise projects for business development
	CO2: Analyze and manage project risks
	CO3: Evaluate various sources of financing for a project
	CO4: Research on project performance, project closure or abandonment situations
FINANCIAL MANAGEMENT	**CROSS FUNCTIONAL ELECTIVES**
1. PERSONAL FINANCE - 18MBA4XFPF	CO1-Evaluate various savings plans, consumer credit and purchasing decisions including housing
	CO2-Take optimal Life and General Insurance subscription decisions
	CO3-Analyze retirement plans and estate planning mechanisms
	CO4-Research for personal investment, portfolio and tax planning
2. COST MANAGEMENT - 18MBA4XFCM	CO1-Apply the concept of cost management

	techniques to solve business problems
	CO2-Analyze and interpret the costing information
	CO3-Evaluate the cost information for cost ascertainment , planning , control and decision making to achieve organizational goals
	CO4-Present the changing scenario in the area of cost management through both oral and written communication

B.M.S. COLLEGE OF ENGINEERING, BENGALURU

Autonomous College, Affiliated to VTU

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

Academic Year 2019-20

Name of the Programme	Master of Computer Applications
PEOs	**PEO 1:** Pursue professional career in the domain of Computer Applications in industry or academia. **PEO 2:** Engage in upgradation of their professional skills leading to certification/higher qualification. **PEO 3:** Demonstrate professional behavior while performing in diverse teams, communicate effectively and contribute to the society.
(POs)	**PO1: Computational Knowledge:** Apply computing knowledge, mathematical knowledge and domain knowledge to identify and capture requirements of specific problems. **PO2: Problem Analysis:** Analyze and develop models for specific problems using principles of mathematics, computing sciences and relevant domains. **PO3: Design/Development of Solutions:** Design, implement, test and maintain solutions for systems, components or processes that meet specific needs with consideration for safety, societal and environmental issues. **PO4: Conduct investigations of Complex Computing Problems:** Conduct required experiments, generate, analyze and interpret the data to draw valid conclusions**.** **PO5: Modern Tool Usage:** Adapt the techniques, skills and modern tools necessary for solving complex computing problems with an understanding of their limitations. **PO6. Professional Ethics:** Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice. **PO7. Life-long Learning:** Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional. **PO8. Project management and finance:** Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. **PO9. Communication Efficacy:** Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions. **PO10. Societal and Environmental Concern:** Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the

	consequential responsibilities relevant to professional computing practice. **PO11. Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments. **PO12. Innovation and Entrepreneurship:** Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.
(COs)	**1. Unix & Advanced C Programming - 18MCA1PCUC** CO1: Describe the concepts of C & UNIX. CO2: Apply the concepts of UNIX and C to solve computing problems. CO3: Analyze a problem and obtain a solution. CO4: Implement programs using C & UNIX for a given problem. **2. Computer Organization - 18MCA1PCCO** CO1: Describe the organization of Digital Computer. CO2: Apply the concepts of Computer Organization for a given problem. CO3: Design memory organization for a computing system. 18MCA1BSDM: Discrete Mathematics CO1: Demonstrate the concepts of Discrete Mathematical Structures. CO2: Apply the concepts of Discrete Mathematical Structures to solve problems. CO3: Formulate a recurrence relation for a given sequence of numbers/pseudocode adopting counting principles. CO4: Work in a team and solve the given set of problems. **3. Discrete Mathematics - 18MCA1BSDM** CO1: Demonstrate the concepts of Discrete Mathematical Structures. CO2: Apply the concepts of Discrete Mathematical Structures to solve problems. CO3: Formulate a recurrence relation for a given sequence of numbers/pseudocode adopting counting principles. CO4: Work in a team and solve the given set of problems. **4. Web Application Development - 18MCA1PCWD** CO1: Describe the concepts of web programming, client side and server side scripting CO2: Apply the knowledge of client and server-side technologies using structured and unstructured data.

	CO3: Analyze the impact of the Web components, client side and server side scripting techniques for building web pages. CO4: Design and validate web pages using scripting languages for a given scenario CO5: Implement programs using web development technologies for various use cases. **5. Operating System - 18MCA1PCOS** CO1: Explain the structure and concepts of an Operating System CO2: Apply the Algorithmic techniques to solve problems related to Operating System. CO3: Implement the concepts related to Operating System CO4: Perform in a team to simulate different Operating System concepts **6. Professional Communication and Ethics - 18MCA1HSPE** CO1: Explain concepts of Oral & Written communication CO2: Apply oral & written communication skill for various use cases. CO3: Perform in a team, to prepare a report & make an effective oral presentation on topics related to legal, ethical, society, environment & health issues **7. Computer Networks - 16MCA3DCN1** CO1: Define and Explain concepts related to Computer Networks. CO2: Apply the Network parameters/Algorithms/Protocols for given problem. CO3: Conduct experiments to demonstrate concepts related to Computer networks using a network Simulation tool. CO4: Perform in a team, submit a report on the impact of Computer Networks on health and environment. **8. Java Programming-I - 16MCA3DCJ1** CO1: Demonstrate an understanding of platform independent Java programming. CO2: Analyze the given scenario and use appropriate concepts to develop Java Programs. CO3: Design and Develop programs using the Java Collection and libraries. CO 4: Conduct experiments using Java Programming language. **9. Object Oriented Modeling & Design - 16MCA3DCOM**

	CO 1: Describe Object Oriented Modeling and Design concepts. CO 2: Apply Object oriented modeling and design concepts for a given scenario CO 3: Design UML diagrams for a scenario. CO 4: Choose an appropriate design pattern and solve the real world scenarios using modern tool. **10. Data Science - 16MCA3DCDA** CO1: Explain the concepts related to data science. CO2: Apply Pre-processing techniques for the data related to a scenario. CO3: Devise Data Analytic models for a scenario. CO4: Interpret the data to draw conclusions related to a scenario under study. **11. Agile Software Development - 16MCA3DEAS** CO 1 Describe agile methods and driving forces for taking an Agile approach to software development. CO 2: Apply best practices to manage Agile projects. CO 3: Formulate project backlogs, measure and monitor the velocity for a given scenario. CO 4: Choose a tailored Agile process that best fits the technical and market demands of a modern software project. **12. Operations Research -16MCA3DEOR** CO 1: Explain the concepts of operation research. CO 2: Formulate a mathematical model for a given problem. CO 3: Apply different linear programming techniques to solve the mathematical model. CO 4: Choose a suitable technique and solve the problems related to transportation, assignment and Game theory. CO 5: Apply CPM and PERT techniques to plan, schedule, and control project activities. **13. UNIX System Programming -16MCA3DEUP** CO1: Explain the concepts of Unix System Programming. CO 2: Apply UNIX/POSIX standards for solving problems. CO 3: Implement Unix commands using Unix System programming API's **14. Seminar–I -16MCA3DCS1** CO1: Present topics in Computer Science to address Legal, ethical, Societal, Environmental, and Health issues. CO2: Apply professional ethics during preparation of report.

	CO3: Demonstrate life-long learning skills. CO4: Demonstrate oral and written communication skills. **15. Software Project Management - 16MCA5DCSP** CO1: Explain the concepts related to Software project management. CO2: Apply the principles of Software project management. CO3: Identify the impact of Stress, Health, Safety, Ethical, Professional etc., concerns of a Software professional CO4: Develop artifacts related to project management in a team. **16. Windows Application Development with C#.NET - 16MCA5DCWD** CO1: Describe the features of .NET framework. CO2: Apply the object oriented Concepts to develop interactive C# programs. CO3: Design and develop web based applications using C# and ASP.NET CO4: Perform in a team to prepare a report for developing an application **17. Mini Project- 16MCA5DPMP** CO1: Formulate the problem and identify the requirements / objectives CO2: Design a suitable model for the problem formulated CO3: Select appropriate tools/ technologies/ concepts to solve the problem. CO4: Demonstrate project management principles. CO5: Write a report and communicate effectively through oral presentation in a team. **18. Mobile Ad Hoc & Sensor Networks -16MCA5DEMN** CO1: Explain the concepts of Wireless Communication, Ad hoc and Wireless Sensor Networks. CO2: Apply the knowledge of routing protocols and design issues in Ad Hoc Networks and Wireless Sensor Networks for a given network scenario CO3: Choose an appropriate parameter, routing protocols / algorithm for a given ad hoc network or Wireless Sensor Network CO4: Work in team to prepare a report on the challenges in

	Wireless Sensor Networks for different real world use cases **19. Web Services -16MCA5DEWS** CO1: Describe the concepts of Web Services CO2: Apply Web services concepts for a given scenario CO3: Work in a team to present a case study on Web services **20. Soft Computing-16MCA5DESC** CO1: Demonstrate the understanding of soft computing concepts CO2: Apply soft computing techniques to solve problems CO3: Analyze and Develop neural networks/fuzzy Logic to implement logical/ Mathematical functions CO4: Design computing systems by using appropriate Soft Computing technique. CO5: Implement Soft Computing techniques to solve a problem using modern tools in a team. **21. Advanced Computer Networks-16MCA5DEAN** CO1: Describe concepts related to Computer Networks. CO2: Apply the networking concepts for a given problem. CO3: Design a solution for a given network scenario. CO4: Demonstrate Networking concepts using Modern Tools through a group activity. **22. Enterprise Resource Planning - 16MCA5DERP** CO1: Demonstrate the concepts of Enterprise Systems. CO2: Apply the ERP concepts for a case study. CO3: Identify the functional modules of an ERP system; CO4: Analyze the ERP concepts & process for a given case study in a team. **23. Mobile Applications -16MCA5DEMA** CO1: Describe the components of mobile application development. CO2: Apply the computing knowledge in developing Android applications. CO3: Design the mobile application for a given problem. CO4: Develop a mobile application in a team and submit a report. **24. Machine Learning -16MCA5DEML** CO1: Explain the concepts of Machine Learning CO2: Apply Machine learning concepts for a scenario.

	CO3: Develop machine learning models for a scenario CO4: Interpret the data to draw conclusions related to a scenario. **25. Organizational Behavior -16MCA5DEOB** CO1: Demonstrate the concepts of organizational behavior. CO2: Apply concepts of organization behavior for different cases and issues. CO3: Perform in a team as a team leader or a member in decision making process of the organization CO4: prepare a report and make an effective oral presentation on the given scenario. **26. Object Oriented Programming with C++ - 18MCA2PCOP** CO1. Describe the features of Object Oriented concepts in C++ CO2. Apply object oriented concepts to solve computing problems. CO3: Analyse the problem and obtain a solution. CO4: Develop Programs for a use case using any modern tools. **27. Data Structures using C - 18MCA2PCDS** CO1: Explain the concepts of data structures CO2: Apply concepts of data structures for various problems CO3: Implement data structures, sorting and searching methods using C CO4: Solve a problem in teams by choosing an appropriate data structure through an open ended experiment **28. Database Management System - 18MCA2PCDB** CO1: Explain the concepts of Database system. CO2: Apply the concepts of relational Database for a scenario. CO3: Analyze and develop Data models for a scenario. CO4: Formulate and implement queries, using a RDBMS package. CO5: Design and build simple real-world database applications in a team and prepare a report. **29. Statistics - 18MCA2PEST** CO1: Explain the Concepts of Statistics CO2: Solve problems using various statistical concepts. CO3: Analyze the data using statistical techniques CO4: Design prediction model for a given data using Regression. CO5: Interpret the data for various scenarios or contexts.

	30. Operations Research - 18MCA2PEOR CO1: Explain the concepts of operation research. CO2: Apply different linear programming techniques to solve the mathematical model. CO3: Formulate a mathematical model for a given problem. CO4: Apply CPM and PERT techniques to plan, schedule, and control project activities. **31. Software Engineering - 18MCA2PCSE** CO1: Explain the concepts of Software Engineering CO2: Apply the concepts of requirement engineering to prepare SRS document. CO3: Analyse various models in software design CO4: Estimate Software Costs for a given scenario CO5: Describe professional and ethical responsibilities of a Software Engineer **32. Entrepreneurship - 18MCA2HSES** CO1: Explain the concept of Innovation & Entrepreneurship CO2: Apply the knowledge of entrepreneurship to various scenarios CO3: Perform in a team, to prepare a report & make effective oral presentation on topics related to Entrepreneurship **33. Seminar -1-18MCA2SRS1** CO1: Present a topic in Computer Science to address Legal, Ethical, Societal, Environmental, and Health issues CO2: Apply professional ethics during preparation of report. CO3: Demonstrate life-long learning skills. CO4: Demonstrate oral and written communication skills. **34. Analysis and Design of Algorithms -16MCA4DCAD** CO1. Demonstrate the understanding of Algorithmic design concepts. CO2. Apply algorithmic design techniques for a given problem. CO3. Analyze algorithm for its correctness / time complexity CO4. Implement an Algorithm either using C or C++. CO5. Develop an Algorithm and prepare a report for a problem in a team. **35. Web Application Development-II - 16MCA4DCW2** CO1. Demonstrate the programming concepts of python. CO2. Apply the object-oriented approach in python programming.

	CO3: Analyse the problem and obtain a solution. CO4: Implement & validate Program using modern tools. CO5: Build web application with graphical user interfaces and database. **36. Java Programming-II-16MCA4DCJ2** CO1: Demonstrate an understanding of event-driven programming with database. CO2: Analyze and develop Web applications using appropriate technologies. CO3: Design and develop distributed applications. CO4: Implement programs using J2EE Technologies. CO5: Work in team to analyze J2EEbased applications and articulate effectively. **37. Simulation & Modeling -16MCA4DESM** CO1: Explain the concepts of simulation and modeling CO2: Apply modeling techniques for discrete event simulation CO3: Design a simulation model for a given scenario CO4: Interpret the simulation results and draw inferences for a given input/output model CO5: Adapt modern tools to simulate a system in a team and write a report. **38. Software Testing -16MCA4DEST** CO1: Demonstrate the concepts of Software testing CO2: Apply software testing techniques for a given problem. CO3: Design test plan & test cases for a given problem. CO4: Perform in a team to prepare a test report for a chosen use case. **39. Mobile Computing & Wireless Communication-16MCA4DEMC** CO1: Understand the concepts of Mobile Computing and Wireless Communication. CO2. Apply the knowledge of various access technologies and frameworks of Wireless Networks. CO3. Analyze the impact of security protocols, algorithms for Mobile Computing Environment and Wireless Networks. CO4. Design a process to aid in migrating from the desktop environment to smart client environment. CO5. Perform in a team to prepare a report on impact of package and billing in different Wireless Networks.

	40. Big-Data Analytics and NOSQL-16MCA4DEBA CO1: Explain the concepts of Big Data and NoSQL databases. CO2: Apply Big Data concepts for a scenario. CO3: Apply NoSQL for Data Management. CO4: Design a Map-Reduce model to process the data for a use case and write a report. **41. Cloud Computing -16MCA4DECC** CO1: Describe the concepts of cloud computing and technologies. CO2: Apply the cloud computing principles for a given scenario CO3: Identify the appropriate cloud services or security implications for a given application. CO4: Work in a team to analyze cloud services and write a report. **42. Internet of Things-6MCA4DEIT** CO1: Explain the concepts of Internet of Things (IoT). CO2: Apply the knowledge of IoT architecture, framework for a specific scenario. CO3: Identify issues and design challenges in IoT applications CO4: Develop an IoT prototype related to the societal or health or environment needs in a team to prepare a poster. **43. Seminar-II -16MCA4DCS2** CO1: Identify the best method among a set of research findings. CO2: Apply professional ethics during preparation of report. CO3: Demonstrate life-long learning skills. CO4: Demonstrate oral and written communication skills. **44. Cyber Regulations & Professional Ethics -16MCA4DCCR** CO1: Understand, define and explain the need of Cyber Law and E-Commerce in the CyberSpace CO2: Apply the knowledge of Cyber Law, privacy issues and the parameters of professional ethics for a given scenario. CO3: Analyze the impact of Cyber law and Information technology on the productivity and quality of life in IT industry. CO4: Perform in a team to prepare a use case and make an effective oral presentation on topics related to legal and health issues. **45. Internship - 16MCA6DPIP** CO1: Analyse the problem and identify the requirements /

	objectives CO2: Adhere to Professional behavior while interacting with people in the organization CO3: Function effectively to engage in independent learning CO4: Write a report and communicate effectively CO5: Demonstrate the importance of Legal, Societal, Environmental and Health issues related to Technologies CO6: Work effectively as a member in a team CO7: Explain the principles of Entrepreneurship used in Industry. **46. Project Work - 16MCA6DPPW** CO1 Apply the computing knowledge for the chosen problem domain CO2 Analyze the problem and identify the requirements / objectives CO3 Design and develop a model / process / algorithm CO4 Conduct required experiments and validate the input and draw valid conclusions CO5 Implement using appropriate software tools / technology CO6 Adhere to ethics during the project development CO7 Function effectively to engage in independent learning CO8 Apply the principles of project management CO9: Prepare a report and poster, and demonstrate the project CO10: Identify Legal/ Ethical/ Societal/ Health or Environmental issues related to project work. CO11: Perform in a team while carrying out a project work. CO12: Generate ideas and identify the business model to convert the project work into a product.

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DEPARTMENT OF PHYSICS

Academic Year 2019-20

Name of the Programme	Engineering Physics
Course Code	18PY1BSPHY & 18PY2BSPHY
Programme Outcomes (POs)	**PO1**: Apply the knowledge of mathematics, science, arts and management principles to the solution of complex problems. **PO4** : Create, select, and apply appropriate techniques, resources, and modern IT tools including prediction and modeling to complex activities with an understanding of the limitations.
Course Outcomes (COs)	**CO1:** Understand and explain the principles of quantum mechanics, transport phenomena, dielectric and semiconductor material properties of solids, laser and optical fiber and concept of vibrations. **CO2**: Apply the principles of quantum mechanics, transport phenomena, dielectric and semiconductor material properties of solids, laser and optical fiber and types of vibrations to obtain a desired parameter. **CO3:** Conduct, analyze and interpret the data and results from applied physics experiments.

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DEPARTMENT OF CHEMISTRY

Academic Year 2019-20

Name of the Programme	B.E. (All branches) UG Programme – I & II Semester 2019-20: 18CY1BSCHY / 18CY2BSCHY Engineering Chemistry
Programme Specific Outcomes (PSOs)	NA
Programme Outcomes (POs)	PO1 to PO12
Course Outcomes (COs)	On completion of the course, the student will have the ability to:
CO 1	Understand and explain the principles of chemistry involved in water treatment, electrochemistry, corrosion and its control, conventional energy sources, electrochemical and renewable sources of energy, polymers, nanomaterials and instrumental methods of analysis.
CO 2	Apply the acquired knowledge to solve the Engineering Chemistry problems.
CO 3	Analyse the Engineering Chemistry problems and draw meaningful inferences
CO 4	Conduct, analyse and interpret the data and results from Engineering Chemistry experiments.

Name of the Programme	B.E. (All branches) UG Programme – VII Semester 2019-20: 17CY7IENMA Nanomaterials - Synthesis, Characterization And Applications
Programme Specific Outcomes (PSOs)	NA
Programme Outcomes (POs)	PO1 to PO12
Course Outcomes (COs)	At the end of the course the student will have:
CO 1	An ability to understand and explain nanoscale materials and properties, varoius methods of synthesis, characterization
CO 2	An ability to apply the learnt knowledge and choose appropriate method to synthesize and characterize nanomaterials.
CO 3	An ability to application of nanomaterials

Name of the Programme	B.E. (All branches) UG Programme – VII Semester 2019-20:17CY7IEEPC Environmental Pollution and Control
Programme Specific Outcomes (PSOs)	NA
Programme Outcomes (POs)	PO1 to PO12
Course Outcomes (COs)	After completion of course students will have:

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CO 1	An ability to identify the components of environmental ecosystems and effect of water, air, soil pollutant on them
CO 2	An ability to apply pollution control measures on air, water and soil pollutants
CO 3	An ability to recognize and control environmental issues in various industries and comprehend engineering solutions.
Name of the Programme	**B.E. (All branches) UG Programme – VIII Semester 2019-20: 17CY8IECSE Corrosion Science & Engineering**
Programme Specific Outcomes (PSOs)	NA
Programme Outcomes (POs)	PO1 to PO12
Course Outcomes (COs)	At the end of the course the student will have:
CO 1	An ability to understand and Explain corrosion principles and various forms of corrosion and its monitoring and corrosion control
CO 2	An Ability to apply the learnt knowledge in testing, monitoring and control of various forms of corrosion
CO 3	An ability to develop methods of science and engineering in testing, monitoring and control of various forms of corrosion

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DEPARTMENT OF MATHEMATICS AND HUMANITIES

Academic Year 2019-20

Name of the Programme	**ENGINEERING MATHEMATICS – 1 (18MA1BSEM1)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1 & PO5
Course Outcomes (COs)	Understand the concepts of Calculus and differential equations. Apply the concepts of calculus and Differential Equations to Engineering Problems. Demonstrate an understanding of the multiple integrals using alternate tools.
Name of the Programme	**ENGINEERING MATHEMATICS – 2 (18MA2BSEM2)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1 & PO5
Course Outcomes (COs)	Understand the concepts of transforms, partial differential equations and vector calculus. Apply the concepts of transforms, partial differential equations and calculus to Engineering problems. Demonstrate an understanding of the Laplace transforms of functions using alternate tools.
Name of the Programme	**ENGINEERING MATHEMATICS – 3 (AS/CV/ECE/EEE/EIE/IEM/ME/ML/TCE) (19MA3BSEM3)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Apply Numerical techniques to solve problems arising in engineering. Demonstrate an understanding of Fourier Series, Fourier Transforms and Z- Transforms. Apply the concepts of calculus to functionals.
Name of the Programme	**APPLIED MATHEMATICS (CHEMICAL/BIOTECHNOLOGY) (19MA3BSAPM)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Apply Numerical techniques to solve problems arising in engineering. Demonstrate an understanding of Fourier Series and Fourier Transforms. Apply the concepts of calculus to functionals.

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Name of the Programme	**STATISTICS AND DISCRETE MATHEMATICS (CSE / ISE) (19MA3BSSDM)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Use graphs as representation tool in network analysis. Demonstrate an understanding of the basic concepts of Combinatorics. Apply the concepts for probability, Statistics and Queuing theory.
Name of the Programme	**HIGHER ENGINEERING MATHEMATICS (MECHANICAL ENGINEERING) (19MA4BSHEM)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Demonstrate an understanding of concepts of statistical analysis and probability distributions. Apply Numerical techniques to solve partial differential equations arising in engineering. Demonstrate an understanding of analytic functions and their application to evaluate integrals.
Name of the Programme	**ENGINEERING MATHEMATICS -4 (AS / CV / ECE / EEE / EIE / ML / TCE) (19MA4BSEM4)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Demonstrate an understanding of concepts of statistical analysis and probability distributions. Apply Numerical techniques to solve partial differential equations arising in engineering. Demonstrate an understanding of analytic functions and their application to evaluate integrals.
Name of the Programme	**BIOSTATISTICS AND PROBABILITY (BT) (19MA4BSBSP)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1, PO2, PO9 & PO10
Course Outcomes (COs)	Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples. Apply the basic principles of probability and Probability distributions to the problems in Engineering. Apply the concepts of Markov chain to the field of

	genetics Demonstrate an understanding of sampling distributions and principles of experimental design.
Name of the Programme	**LINEAR ALGEBRA (CSE & ISE) (19MA4BSLIA)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Apply the concepts of Matrices to linear systems and Vectors spaces. Relate the concepts of Eigen values, Eigen vectors & functions to linear algebra. Apply the concepts of inner products to matrix decomposition.
Name of the Programme	**STATISTICS & PROBABILITY (Chemical) (19MA4BSSAP)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1, PO2, PO9 & PO10
Course Outcomes (COs)	Appreciate the use of Statistical methods to Analyze and interpret the data from real world examples. Apply the basic principles of probability and Probability distributions to the problems in Engineering. Apply the concepts of Markov chain to the field of genetics. Demonstrate an understanding of sampling distributions and principles of experimental design.
Name of the Programme	**NUMBER THEORY – INSTITUTIONAL ELECTIVE (16MA7IENMT)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Apply the concept of congruence to compute system of equations (algebraic equations). Demonstrate and understanding towards the nature of different functions. Demonstrate and understanding primitive roots and indices. Apply concept of quadratic congruence to evaluate quadratic residues and understand continued fractions. Identify the nature of large number by means of different algorithm.

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DEPARTMENT OF MATHEMATICS AND HUMANITIES

Name of the Programme	**COMPUTATIONAL GRAPH THEORY – INSTITUTIONAL ELECTIVE (16MA7IECGT)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1, PO2 & PO5
Course Outcomes (COs)	Demonstrate an understanding of the fundamental concepts of graph theory including but not limited to graphs, digraphs, trees, finding Paths and cycles, planarity, weighted graphs matching and graph coloring. Apply appropriate graph algorithms to solve problems involving transportation, connection, social networking and scheduling. Analyse the algorithms to find the shortest path, maximum flow of minimum cost, maximum matching and minimum path cover. Use graphs as representation tools in a network analysis. Model real world problems such as Job sequencing, timetabling, sport scheduling, Chinese postman problem, travelling salesman problem, minimum weight spanning tree and problems on stable matching's using graphs. Use of matlab to find the shortest path, minimum weighted spanning tree, maximum flow.
Name of the Programme	**LINEAR ALGEBRA – INSTITUTIONAL ELECTIVE (16MA8IELIA)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1
Course Outcomes (COs)	Apply the concepts of matrix theory to vector spaces. Construct the matrix associated with a linear transformation and analyze the rank and nullity. Compute the eigenvalues and eigenvectors. Relate the knowledge of inner product spaces to orthogonalization process and least squares solutions. Construct the Singular value decomposition of a given matrix.
Name of the Programme	**OPERATIONS RESEARCH – INSTITUTIONAL ELECTIVE (16MD8IEOPR)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO1 to PO4
Course Outcomes (COs)	Formulate a real-world problem as a mathematical

	programming model. Formulate and solve transportation models by applying cost cutting strategies. Formulate and solve assignment models and travelling salesmen problems. Construct a project network and apply program evaluation review technique and critical path management. Employ Game theory for strategic decision making.
Name of the Programme	**FUNCTIONAL ENGLISH (18HS1NCENG/ 18HS2NCENG)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO9 & PO10
Course Outcomes (COs)	Communicate effectively and creatively in both non-verbal and verbal forms in various multi-disciplinary activities. Upgrade organizational skills/traits, team spirit/working in liaison and thus boost professional etiquette and ethics. Write effective technical reports, dissertation and project documents and make effective oral and written presentations. Enhance employability via training in writing correct and effective Applications/Resumes. Perform well against Domestic and International Industry Standards via group discussions and Power Point Presentations. Strengthen basic grammar components/structures and overcome mistakes/wrong pronunciation and thereby, encourage speaking/writing in flawless English.
Name of the Programme	**SAMSKRUTHIKA KANNADA (Karnataka Students) (20HS3ICSAK / 20HS4ICSAK)** **BALAKE KANNADA (Non-Karnataka Students) (20HS3ICBAK / 20HS4ICBAK)**
Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	--
Course Outcomes (COs)	The course will enable the non-Karnataka students to understand speak read and write Kannada language and communicate (converse) in Kannada language in their daily life with Kannada speakers.
Name of the Programme	**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND HUMAN RIGHTS (19IC3HSCPH / 19IC4HSCPH)**

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Programme Specific Outcomes (PSOs)	--
Programme Outcomes (POs)	PO6 & PO8
Course Outcomes (COs)	Understand and explain the significance of Indian Constitution as the Fundamental Law of the Land. Analyse the concepts and ideas of Human Rights. Apply the practice of ethical responsibilities and duties to protect the welfare and safety of the public.

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