PROGRAMME OUTCOME, PROGRAMMESPECIFIC OUTCOMES AND COURSEOUTCOMES OF ALL DEPARTMENTS–2020-21(CRITERIA- 2)

2.6.1 Program outcomes, program specific outcomes and course outcomes

Department of Civil Engineering

Program Outcomes (PO's)

PO 1: To apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems

PO 2: To identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO 3: To 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.

PO 4: To 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.

PO 5: To create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of limitations.

PO 6: To apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice

PO 7: To understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO 8: To apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO 9: To function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: To communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: To 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.

PO 12: To recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

PSO1: Capable to study, plan, analyse and design the civil engineering structures required for the professional demands.

PSO2: Utilize the appropriate software and related modern tools to develop skills to plan, produce detailed drawings, write specifications, and prepare cost estimates of civil engineering structures.

PSO3: Offer engineering services with professional, environmental and ethical responsibility.

Course Outcomes	ADVANCED STRUCTURAL ANALYSIS- 20CSE11
CO1	Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members
CO2	Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation
CO3	Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamental.
CO4	Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending
CO5	Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column
Course Outcomes	**MATRIX METHODS OF STRUCTURAL ANALYSIS- 20CSE12**
CO1	Formulate force displacement relation by flexibility and stiffness method
CO2	Analyze the plane trusses, continuous beams and portal frames by transformation approach
CO3	Analyse the structures by direct stiffness method
Course Outcomes	**Advanced design of RCC structures - 20CSE13**
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Design
CO3	Design and develop analytical skills.
CO4	Summarize the principles of Structural Design and detailing
CO5	Understands the structural performance.
Course Outcomes	**MECHANICS OF DEFORMABLE BODIES - 20CSE14**
CO1	Achieve Knowledge of design and development of problem solving skills
CO2	Understand the principles of stress-strain behaviour of continuum
CO3	Design and develop analytical skills
CO4	Describe the continuum in 2 and 3- dimensions
CO5	Understand the concepts of elasticity and plasticity.
Course Outcomes	**STRUCTURAL DYNAMICS – 20CSE15**
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Dynamics
CO3	Design and develop analytical skills.
CO4	Summarize the Solution techniques for dynamics of Multi-degree freedom systems
CO5	Understand the concepts of damping in structures.
Course Outcomes	**Structural engineering lab 1 -20CSEL16**
CO1	Achieve Knowledge of design and development of experimenting skills.
CO2	Understand the principles of design of experiments
CO3	Design and develop analytical skills.
CO4	Summarize the testing methods and equipments.
Course Outcomes	**RESEARCH METHODOLOGY AND IPR -20RMI17**
CO1	Discuss research methodology and the technique of defining a research problem

CO2	Explain the functions of the literature review in research, carrying out a literature search, developing
CO3	Explain various research designs and their characteristics.
CO4	Explain the art of interpretation and the art of writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR
Course Outcomes	**ADVANCED DESIGN OF STEEL STRUCTURES - 20CSE21**
CO1	Able to understand behavior of Light gauge steel members
CO2	Able to understand design concepts of cold formed/unrestrained beams
CO3	Able to understand Fire resistance concept required for present days.
CO4	Able to analyze beam column behavior
Course Outcomes	**FINITE ELEMENT METHOD OF ANALYSIS - 20CSE22**
CO1	Explain the basic theory behind the finite element method.
CO2	Formulate force-displacements relations for 2-D elements
CO3	Use the finite element method to analyze real structures.
CO4	Use a Finite Element based program for structural analysis
Course Outcomes	**EARTHQUAKE RESISTANT STRUCTURES - 20CSE23**
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of engineering seismology and concepts of earthquake resistance of reinforced concrete buildings.
CO3	Design and develop analytical skills.
CO2	Understand the concepts of earthquake resistance of reinforced concrete buildings.
CO4	Summarize the Seismic evaluation and retrofitting of structures.
Course Outcomes	**ADVANCED DESIGN OF PRE- STRESSED CONCRETE STRUCTURES (Elective 1) - 20CSE242**
CO1	Analyse , Design and detail PSC elements
Course Outcomes	**ADVANCED STRUCTURAL ANALYSIS (Elective 2) - 18CSE251**
CO1	Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members
CO2	Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation
CO3	Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamental
CO4	Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending
CO5	Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column
Course Outcomes	**DESIGN OF TALL STRUCTURES (Elective 2) - 20CSE252**
CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of strength and stability
CO3	Design and develop analytical skills.
CO4	Summarize the behavior of various structural systems.
CO5	Understand the concepts of P-Delta analysis

Course Outcomes	STRUCTURAL ENGINEERING LAB-2 -20CSEL26
CO1	Achieve Knowledge of design and development of programming skills.
CO2	Understand the principles of structural analysis and design
CO3	Design and develop analytical skills
CO4	Summarize the performance of structures for static and dynamic forces.
Course Outcomes	**DESIGN OF BRIDGES - 20CSE31**
CO1	Describe historical growth, select ideal site and bridge, calculate values of design parameters of slab culvert at critical section as per IRC, design and detailing required for the execution of the project.
CO2	Carry out analysis of box culvert as per IRC to obtain the values of design parameters and to design and detail the components following IS code procedure.
CO3	Demonstrate the use of Pigeauds Method and Courbon's Methodin the analysis of T beam bridge as per IRC, design to obtain the safe dimensions various components, optimum reinforcement required following IS code procedure.
CO4	Display the use of Courbon's Methodin the analysis of PSC bridge as per IRC, design to obtain the safe value of pre stressing force, obtain the dimensions of various components to keep the stresses within codal provisions following IS code procedure.
CO 5	Analysis a balanced cantilever bridge as per IRC and to obtain the safe values of design parameters and to design and detail the components as per IS code procedure
Course Outcomes	**DESIGN CONCEPTS OF SUBSTRUCTURES (Elective- 1) - 20CSE321**
CO1	Achieve Knowledge of design and development of problem solving skills
CO2	Understand the principles of subsoil exploration
CO3	Design and develop analytical skills.
CO4	Understand the concepts of Settlement analysis.
Course Outcomes	**FRACTURE MECHANICS APPLIED TO CONCRETE (Elective 2) - 20CSE331**
CO1	Apply principles of fracture mechanics.
CO2	Design concrete structures using fracture mechanics approach.
CO3	Explain the importance of fracture mechanics.
CO4	Take special care of very large sized structures
Course Outcomes	**PROJECT WORK PHASE -2 - 20CSE41**

COs of All Programs

CIVIL ENGINEERING	
Course Code	**TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES - 18MAT31**
C01	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
CO2	Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.
CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
CO5	Determine the externals of functional using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
Course Code	**STRENGTH OF MATERIALS - 18CV32**
C01	To evaluate the basic concepts of the stresses and strains for different materials and strength of structural elements.
CO2	To evaluate the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
CO3	To analyse different internal forces and stresses induced due to representative loads on structural elements.
CO4	To evaluate slope and deflections of beams.
CO5	To evaluate the behaviour of torsion members, columns and struts.
Course Code	**FLUIDS MECHANICS - 18CV33**
C01	Possess a sound knowledge of fundamental properties of fluids and fluid continuum
CO2	Compute and solve problems on hydrostatics, including practical applications
CO3	Apply principles of mathematics to represent kinematic concepts related to fluid flow
CO4	Apply fundamental laws of fluid mechanics and the Bernoulli's principle for practical applications
CO5	Compute the discharge through pipes and over notches and weirs
Course Code	**SBUILDING MATERIALS AND CONSTRUCTION - 18CV34**
C01	Select suitable materials for buildings and adopt suitable construction techniques.
CO2	Decide suitable type of foundation based on soil parameters
CO3	Supervise the construction of different building elements based on suitability
CO4	Exhibit the knowledge of building finishes and form work requirements
Course Code	**BUILDING MATERIALS AND CONSTRUCTION - 18CV34**

C01	Select suitable materials for buildings and adopt suitable construction techniques.
CO2	Decide suitable type of foundation based on soil parameters
CO3	Supervise the construction of different building elements based on suitability
CO4	Exhibit the knowledge of building finishes and form work requirements
Course Code	**BASIC SURVEYING - 18CV35**
C01	Posses a sound knowledge of fundamental principles Geodetics
CO2	Measurement of vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.
CO3	Capture geodetic data to process and perform analysis for survey problems
CO4	Analyse the obtained spatial data and compute areas and volumes. Represent 3D data on plane figures as contours
Course Code	**ENGINEERING GEOLOGY - 18CV36**
C01	Apply geological knowledge in different civil engineering practice.
CO2	Students will acquire knowledge on durability and competence of foundation rocks, and confidence enough to use the best building materials.
CO3	Civil Engineers are competent enough for the safety, stability, economy and life of the structures that they construct.
CO4	Able to solve various issues related to ground water exploration, build up dams, bridges, tunnels which are often confronted with ground water problems.
CO5	Intelligent enough to apply GIS, GPS and remote sensing as a latest tool in different civil engineering construction.
Course Code	**COMPUTER AIDED BUILDING PLANNING AND DRAWING - 18CVL37**
C01	Prepare, read and interpret the drawings in a professional set up.
CO2	Know the procedures of submission of drawings and Develop working and submission drawings for building.
CO3	Plan and design aresidential or public building as per the given requirements.
Course Code	**BUILDING MATERIALS TESTING LABORATORY - 18CVL38**
C01	Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion.
CO2	Identify, formulate and solve engineering problems of structural elements subjected to flexure.
CO3	Evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to unsuitable materials.
Course Code	**ADDITIONAL MATHEMATICS – I 18MATDIP31**
C01	Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
CO2	Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
CO3	Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
CO4	Learn techniques of integration including the evaluation of double and triple integrals.
CO5	Identify and solve first order ordinary differential equations.
Course Code	**COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHOD 18CV41**
C01	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.

CO2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
CO3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
Course Code	**ANALYSIS OF DETERMINATE STRUCTURES - 18CV42**
C01	Identify different forms of structural systems.
CO2	Construct ILD and analyse the beams and trusses subjected to moving loads
CO3	Understand the energy principles and energy theorems and its applications to determine the deflections of trusses and beams.
CO4	Determine the stress resultants in arches and cables.
Course Code	**APPLIED HYDRAULICS - 18CV43**
C01	Apply dimensional analysis to develop mathematical modeling and compute the parametric values in prototype by analyzing the corresponding model parameters
CO2	Design the open channels of various cross sections including economical channel sections
CO3	Apply Energy concepts to flow in open channel sections, Calculate Energy dissipation,
CO4	Compute water surface profiles at different conditions
CO5	Design turbines for the given data, and to know their operation characteristics under different operating conditions
Course Code	**CONCRETE TECHNOLOGY - 18CV44**
C01	Relate material characteristics and their influence on microstructure of concrete.
C02	Distinguish concrete behavior based on its fresh and hardened properties.
C03	Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes.
C04	Adopt suitable concreting methods to place the concrete based on requirement.
C05	Select a suitable type of concrete based on specific application.
Course Code	**ADVANCED SURVEYING - 18CV45**
C01	Apply the knowledge of geometric principles to arrive at surveying problems
CO2	Use modern instruments to obtain geo-spatial data and analyse the same to appropriate engineering problems.
CO3	Capture geodetic data to process and perform analysis for survey problems with the use of electronic instruments
CO4	Design and implement the different types of curves for deviating type of alignments.
Course Code	**WATER SUPPLY AND TREATMENT ENGINEERING - 18CV46**
C01	Estimate average and peak water demand for a community.
C02	Evaluate available sources of water, quantitatively and qualitatively and make appropriate choice for a community.
C03	Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
C04	Design a comprehensive water treatment and distribution system to purify and distribute water The required quality standards.

Course Code	ENGINEERING GEOLOGY LABORATORY - 18CVL47
C01	The students able to identify the minerals, rocks and utilize them effectively in civil engineering practices.
C02	The students will interpret and understand the geological conditions of the area for implementation of civil engineering projects.
C03	The students will interpret subsurface information such as thickness of soil, weathered zone, depth of hard rock and saturated zone by using geophysical methods.
C04	The students will learn the techniques in the interpretation of LANDSAT Imageries to find out the lineaments and other structural features for the given area.
C05	The students will be able to identify the different structures in the field.
Course Code	**FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY - 18CVL48**
C01	Properties of fluids and the use of various instruments for fluid flow measurement.
CO2	Working of hydraulic machines under various conditions of working and their characteristics.
Course Code	**ADDITIONAL MATHEMATICS – II 18MATDIP41**
C01	Solve systems of linear equations using matrix algebra.
C02	Apply the knowledge of numerical methods in modelling and solving of engineering problems.
C03	Apply the knowledge of numerical methods in modelling and solving of engineering problems.
C04	Classify partial differential equations and solve them by exact methods.
C05	Apply elementary probability theory and solve related problems.
Course Code	**CONSTRUCTION MANAGEMENT AND ENTREPRENEURSHIP - 18CV51**
C01	Prepare a project plan based on requirements and prepare schedule of a project by understanding the activities and their sequence.
CO2	Understand labour output, equipment efficiency to allocate resources required for an activity / project to achieve desired quality and safety.
CO3	Analyze the economics of alternatives and evaluate benefits and profits of a construction activity based on monetary value and time value.
CO4	Establish as an ethical entrepreneur and establish an enterprise utilizing the provisions offered by the federal agencies.
Course Code	**ANALYSIS OF INDETERMINATE STRUCTURES - 18CV52**
C01	Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope defection method
CO2	Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method.
CO3	Construct the bending moment diagram for beams and frames by Kani's method.
	Construct the bending moment diagram for beams and frames using flexibility method
CO4	Analyze the beams and indeterminate frames by system stiffness method.
Course Code	**DESIGN OF RC STRUCTURAL ELEMENTS - 18CV53**
C01	Understand the design philosophy and principles.
CO2	Solve engineering problems of RC elements subjected to flexure, shear and torsion.
CO3	Demonstrate the procedural knowledge in designs of RC structural elements such as slabs, columns and footings.
CO4	Owns professional and ethical responsibility.

Course Code	BASIC GEOTECHNICAL ENGINEERING - 18CV54
C01	Ability to plan and execute geotechnical site investigation program for different civil engineering projects
CO2	Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
CO3	Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
CO4	Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
CO5	Capable of estimating load carrying capacity of single and group of piles
Course Code	**MUNICIPAL WASTEWATER ENGINEERING - 18CV55**
C01	Select the appropriate sewer appurtenances and materials in sewer network.
CO2	Design the sewers network and understand the self purification process in flowing water.
CO3	Deisgn the varies physic- chemical treatment units
CO4	Design the various biological treatment units
CO5	Design various AOPs and low cost treatment units.
Course Code	**HIGHWAY ENGINEERING - 18CV56**
C01	Acquire the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data.
CO2	Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction.
CO3	Design road geometrics, structural components of pavement and drainage.
CO4	Evaluate the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts.
Course Code	**SURVEYING PRACTICE - 18CVL57**
C01	Apply the basic principles of engineering surveying and for linear and angular measurements.
CO2	Comprehend effectively field procedures required for a professional surveyor.
CO3	Use techniques, skills and conventional surveying instruments necessary f o r engineering practice.
Course Code	**CONCRETE AND HIGHWAY MATERIALS LABORATORY - 18CVL58**
C01	Able to interpret the experimental results of concrete and highway materials based on laboratory tests.
C02	Determine the quality and suitability of cement.
C03	Design appropriate concrete mix Using Professional codes.
C04	Determine strength and quality of concrete.
C05	Evaluate the strength of structural elements using NDT techniques.
C06	Test the soil for its suitability as sub grade soil for pavements.
Course Code	**DESIGN OF STEEL STRUCTURAL ELEMENTS - 18CV61**
C01	Possess knowledge of Steel Structures Advantages and Disadvantages of Steel structures, steel code provisions and plastic behaviour of structural steel.
C02	Understand the Concept of Bolted and Welded connections.
C03	Understand the Concept of Design of compression members, built-up columns and columns splices.

C04	Understand the Concept of Design of tension members, simple slab base and gusseted base.
C05	Understand the Concept of Design of laterally supported and un-supported steel beams.
Course Code	**APPLIED GEOTECHNICAL ENGINEERING - 18CV62**
C01	Ability to plan and execute geotechnical site investigation program for different civil engineering projects
C02	Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
C03	Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
C04	Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
C05	Capable of estimating load carrying capacity of single and group of piles
Course Code	**HYDROLOGY AND IRRIGATION ENGINEERING - 18CV63**
C01	Understand the importance of hydrology and its components.
C02	Measure precipitation and analyze the data and analyze the losses in precipitation.
C03	Estimate runoff and develop unit hydrographs.
C04	Find the benefits and ill-effects of irrigation.
C05	Find the quantity of irrigation water and frequency of irrigation for various crops.
C06	Find the canal capacity, design the canal and compute the reservoir capacity.
Course Code	**MATRIX METHOD OF STRUCTURAL ANALYSIS (Elective) - 18CV641**
C01	Evaluate the structural systems to application of concepts of flexibility and stiffness matrices for simple problems.
C02	Identify, formulate and solve engineering problems with respect to flexibility and stiffness matrices as applied to continuous beams, rigid frames and trusses.
C03	Identify, formulate and solve engineering problems by application of concepts of direct stiffness method as applied to continuous beams and trusses.
C04	Evaluate secondary stresses.
Course Code	**SOLID WASTE MANAGEMENT (Elective) - 18CV642**
C01	Analyse existing solid waste management system and to identify their drawbacks.
CO2	Evaluate different elements of solid waste management system.
CO3	Suggest suitable scientific methods for solid waste management elements.
CO4	Design suitable processing system and evaluate disposal sites.
Course Code	**ALTERNATE BUILDING MATERIALS (Elective) - 18CV643**
C01	Solve the problems of Environmental issues concerned to building materials and cost effective building technologies;
C02	Select appropriate type of masonry unit and mortar for civil engineering constructions; also they are able to Design Structural Masonry Elements under Axial Compression.
C03	Analyse different alternative building materials which will be suitable for specific climate and in an environmentally sustainable manner. Also capable of suggesting suitable agro and industrial wastes as a building material.
C04	Recommend various types of alternative building materials and technologies and design a energy efficient building by considering local climatic condition and building material.
Course Code	**GROUND IMPROVEMENT TECHNIQUES (Elective) - 18CV644**
CO1	Give solutions to solve various problems associated with soil formations having less strength.

CO2	Use effectively the various methods of ground improvement techniques depending upon the requirements.
CO3	utilize properly the locally available materials and techniques for ground improvement so that economy in the design of foundations of various civil engineering structures
Course Code	**RAILWAYS, HARBOUR, TUNNELING AND AIRPORTS (Elective) - 18CV645**
C01	Acquires capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway.
CO2	Suggest and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive.
CO3	Develop layout plan of airport, harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same.
CO4	Apply the knowledge gained to conduct surveying, understand the tunneling activities.
Course Code	**REMOTE SENSING AND GIS (Elective) -18CV651**
C01	Collect data and delineate various elements from the satellite imagery using their spectral signature.
CO2	Analyze different features of ground information to create raster or vector data.
CO3	Perform digital classification and create different the maticmaps for solving specific problems
CO4	Make decision based on the GIS analysis on thematic maps.
Course Code	**TRAFFIC ENGINEERING(Elective) - 18CV652**
C01	Understand the human factors and vehicular factors in traffic engineering design.
CO2	Conduct different types of traffic surveys and analysis of collected data using statistical concepts.
CO3	Use anappropriate traffic flow theory and to comprehend the capacity & signalized intersection analysis.
CO4	Understand the basic knowledge of Intelligent Transportation System.
Course Code	**OCCUPATIONAL HEALTH AND SAFETY (Elective) - 18CV653**
C01	Identify hazards in the work place that poseadangeror threat to their safety or health, orthatofothers.
CO2	Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
CO3	Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
CO4	Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
CO5	Identify the decisions required to maintain protection of the environment, workplace as well as personal
Course Code	**SUSTAINABILITY CONCEPTS IN CIVIL ENGINEERING (Elective) - 18CV654**
C01	Learn the sustainability concepts; understand the role and responsibility of engineers in Sustainable Development.
CO2	Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits.
CO3	Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.

CO4	Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society.
Course Code	**SOFTWARE APPLICATION LABORATORY - 18CVL66**
C01	Use software skills in a professional set up to automate the work and thereby reduce cycle time for completion of the work
Course Code	**ENVIRONMENTAL ENGINEERING LABORATORY - 18CVL67**
C01	Acquire capability to conduct experiments and estimate the concentration of different parameters.
CO2	Compare the result with standards and discuss based on the purpose of analysis.
CO3	Determine type of treatment, degree of treatment for water and waste water.
CO4	Identify the parameter to be analyzed for the student project work in environmental stream.
Course Code	**EXTENSIVE SURVEY PROJECT - 18CVP68**
C01	Apply Surveying knowledge and tools effectively for the projects
CO2	Understanding Task environment, Goals, responsibilities, Task focus, working in Teams towards common goals, Organizational performance expectations, technical and behavioral competencies.
CO3	Application of individual effectiveness skills in team and organizational context, goal setting, time management, communication and presentation skills.
CO4	Professional etiquettes at workplace, meeting and general
CO5	Establishing trust based relationships in teams & organizational environment
CO6	Orientation towards conflicts in team and organizational environment, Understanding sources of conflicts, Conflict resolution styles and techniques
Course Code	**QUANTITY SURVEYING AND CONTRACT MANAGEMENT - 18CV71**
C01	Taking out quantities and work out the cost and preparation of abstract for the estimated cost for various civil engineering works.
CO2	Prepare detailed and abstract estimates for various road works, structural works and water supply and sanitary works.
CO3	Prepare the specifications and analyze the rates for various items of work.
CO4	Assess contract and tender documents for various construction works.
CO5	Determine the externals of functional and solve the simple problem of the calculus of variations.
Course Code	**DESIGN OF RCC AND STEEL STRUCTURES - 18CV72**
C01	Students will acquire the basic knowledge in design of RCC and Steel Structures.
CO2	Students will have the ability to follow design procedures as per codal provisions and skills to arrive at structurally safe RC and Steel members.
Course Code	**THEORY OF ELASTICITY (Elective-1) - 18CV731**
C01	Ability to apply knowledge of mechanics and mathematics to model elastic bodies as continuum.
CO2	Ability to formulate boundary value problems; and calculate stresses and strains.
CO3	Ability to comprehend constitutive relations for elastic solids and compatibility constraints.
CO4	Ability to solve two-dimensional problems (plane stress and plane strain) using the concept of stress function
Course Code	**AIR POLLUTION AND CONTROL (Elective-1) - 18CV732**
C01	Identify the major sources of air pollution and understand their effects on health and environment.

CO2	Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
CO3	Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
CO4	Choose and design control techniques for particulate and gaseous emissions.
Course Code	**PAVEMENT MATERIALS AND CONSTRUCTION (Elective-1) - 18CV733**
C01	Students will be able to evaluate and assess the suitability of any pavement material to be used in various components of pavement by conducting required tests as per IS,IRC specifications
CO2	Students will be able to formulate the proportions of different sizes of aggregates to suit gradation criteria for various mixes as per MORTH and also design bituminous mixes.
CO3	Students will be competent to adapt suitable modern technique and equipment for speedy and economic construction.
CO4	Student will be able to execute the construction of embankment, flexible, rigid pavement and perform required quality control tests at different stages of pavement construction.
Course Code	**GROUND WATER HYDRAULICS (Elective-1) - 18CV734**
C01	Find the characteristics of aquifers
CO2	Estimate the quantity of ground water by various methods.
CO3	Locate the zones of ground water resources.
CO4	Select particular type of well and augment the ground water storage.
Course Code	**MASONRY STRUCTURES (Elective-1) - 18CV735**
C01	Select suitable material for masonry construction by understanding engineering properties.
CO2	Compute loads, load combinations and analyze the stresses in masonry.
CO3	Design masonry under compression (Axial load) for various requirements and conditions.
CO4	Design masonry under bending (Eccentric, lateral, transverse load) for various requirements and conditions.
CO5	Assess the behavior of shear wall and reinforced masonry.
Course Code	**EARTHQUAKE ENGINEERING (Elective-2) -18CV741**
C01	Acquire basic knowledge of engineering seismology.
CO2	Develop response spectra for a given earthquake time history and its implementation to estimate response of a given structure.
CO3	Understanding of causes and types of damages to civil engineering structures during different earthquake scenarios.
CO4	Analyze multi-storied structures modeled as shear frames and determine lateral force distribution due to earthquake input motion using IS-1893 procedures.
CO5	Comprehend planning and design requirements of earthquake resistant features of RCC and Masonry structures thorough exposure to different IS-codes of practices.
Course Code	**DESIGN CONCEPT OF BUILDING SERVICES (Elective-2) - 18CV742**
C01	Describe the basics of house plumbing and waste water collection and disposal.
CO2	Discuss the safety and guidelines with respect to fire safety.
CO3	Describe the issues with respect to quantity of water, rain water harvesting and roof top harvesting.
CO4	Understand and implement the requirements of thermal comfort in buildings.
Course Code	**REINFORCED EARTH STRUCTURES (Elective-2) - 18CV743**
C01	Identify, formulate reinforced earth techniques that are suitable for different soils and in different structures;

CO2	Understand the laboratory testing concepts of Geo synthetics
CO3	Design RE retaining structures and Soil Nailing concepts
CO4	Determine the load carrying capacity of Foundations resting on RE soil bed.
Course Code	**DESIGN OF HYDRAULIC STRUCTURES (Elective-2) - 18CV744**
C01	Check the stability of gravity dams and design the dam.
CO2	Estimate the quantity of seepage through earth dams.
CO3	Design spillways and aprons for various diversion works.
CO4	Select particular type of canal regulation work for canal network.
Course Code	**URBAN TRANSPORT PLANNING (Elective-2) - 18CV745**
C01	Design, conduct and administer surveys to provide the data required for transportation planning.
CO2	Supervise the process of data collection about travel behavior and analyze the data for use in transport planning.
CO3	Develop and calibrate modal split, trip generation rates for specific types of land use developments.
CO4	Adopt the steps that are necessary to complete a long-term transportation plan.
Course Code	**FINITE ELEMENT METHOD (Elective-3) -18CV751**
C01	The student will have the knowledge on advanced methods of analysis of structures.
Course Code	**NUMERICAL METHODS AND APPLICATIONS (Elective-3) - 18CV752**
C01	The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from Industry, management and other engineering fields.
Course Code	**ENVIRONMENTAL PROTECTION AND MANAGEMENT - (Elective-3)**
C01	Appreciate the elements of Corporate Environmental Management systems complying to international environmental management system standards.
CO2	Lead pollution prevention assessment team and implement waste minimization options.
CO3	Develop, Implement, maintain and Audit Environmental Management systems for Organizations.
Course Code	**COMPUTER AIDED DETAILING OF STRUCTURES - 18CVL76**
C01	Prepare detailed working drawings of Steel Structures
CO2	Prepare detailed working drawings of RCC Structures
Course Code	**GEOTECHNICAL ENGINEERING LABORATORY -18CVL77**
C01	Physical and index properties of the soil
CO2	Classify based on index properties and field identification
CO3	To determine OMC and MDD, plan and assess field compaction program
CO4	Shear strength and consolidation parameters to assess strength and deformation characteristics
Course Code	**DESIGN OF PRE- STRESSECONCRETE - 18CV81**
C01	Understand the requirement of PSC members for present scenario.
CO2	Analyse the stresses encountered in PSC element during transfer and at working.
CO3	Understand the effectiveness of the design of PSC after studying losses
CO4	Capable of analyzing the PSC element and finding its efficiency
CO5	Design PSC beam for different requirements.

Course Code	BRIDGE ENGINEERING (Elective-2) -18CV821
C01	Understand the load distribution and IRC standards.
CO2	Design the slab and T beam bridges.
CO3	Design Box culvert, pipe culvert
CO4	Use bearings, hinges and expansion joints
CO5	Design Piers and abutments.
Course Code	**PREFABRICATED STRUCTURES (Elective-2) -18CV822**
C01	Use modular construction, industrialized construction
CO2	Design prefabricated elements
CO3	Design some of the prefabricated elements
CO4	Use the knowledge of the construction methods and prefabricated elements in buildings
Course Code	**ADVANCED FOUNDATION ENGINEERING (Elective-2) - 18CV823**
C01	Estimate the size of isolated and combined foundations to satisfy bearing capacity and settlement criteria.
CO2	Estimate the load carrying capacity and settlement of single piles and pile groups including laterally loaded piles.
CO3	Understand the basics of analysis and design principles of well foundation, drilled piers and caissons.
CO4	Understand basics of analysis and design principles of machine foundations.
Course Code	**REHABILITATION AND RETROFITTING (Elective-2) - 18CV824**
C01	Identify the causes for structural (Concrete) deterioration.
CO2	Assess the type and extent of damage and carry out damage assessment of structures through various types of tests.
CO3	Recommend maintenance requirements of the buildings and preventive measures against influencing factors.
Course Code	**PAVEMENT DESIGN (Elective-2) - 18CV825**
C01	Systematically generate and compile required data's for design of pavement (Highway & Airfield).
CO2	Analyze stress, strain and deflection by boussinesq's, bur mister's and westergaard's theory.
CO3	Design rigid pavement and flexible pavement conforming to IRC58-2002 and IRC37-2001
CO4	Evaluate the performance of the pavement and also develops maintenance statement based on site specific requirements
Course Code	**PROJECT WORK PHASE-2 - 18CVP83**
C01	Describe the project and be able to defend it.
CO2	Develop critical thinking and problem solving skills.
CO3	Learn to use modern tools and techniques.
CO4	Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
C05	Develop skills to work in a team to achieve common goal.
CO6	Develop skills of project management and finance.
CO7	Develop skills of self learning, evaluate their learning and take appropriate actions to improve it.
CO8	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Course Code	TECHNICAL SEMINAR - 18CVS84
C01	Develop knowledge in the field of Civil Engineering and other disciplines through independent learning and collaborative study
CO2	Identify and discuss the current, real-time issues and challenges in engineering & technology.
CO3	Develop written and oral communication skills.
C04	Explore concepts in larger diverse social and academic contexts.
CO5	Apply principles of ethics and respect in interaction with others.
CO6	Develop the skills to enable life-long learning.
Course Code	**INTERNSHIP /PROFESSIONAL PRACTICE - 18CVI85**
CO1	Students will get the field exposure and experience

Course Outcomes	Computational structural mechanics - 18CSE11
C01	Formulate force displacement relation by flexibility and stiffness method
CO2	Analyze the plane trusses, continuous beams and portal frames by transformation approach
CO3	Analyse the structures by direct stiffness method
Course Outcomes	**Advanced design of RCC structures - 18CSE12**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of Structural Design
CO3	Design and develop analytical skills.
CO4	Summarize the principles of Structural Design and detailing
CO5	Understands the structural performance.
Course Outcomes	**Mechanics of deformable bodies - 18CSE13**
C01	a. Achieve Knowledge of design and development of problem solving skills
CO2	b. Understand the principles of stress-strain behaviour of continuum
CO3	c. Design and develop analytical skills
CO4	d. Describe the continuum in 2 and 3- dimensions
CO5	e. Understand the concepts of elasticity and plasticity.
Course Outcomes	**Structural dynamics – 18CSE14**
C01	a. Achieve Knowledge of design and development of problem solving skills.
CO2	b. Understand the principles of Structural Dynamics
CO3	c. Design and develop analytical skills.
C04	d. Summarize the Solution techniques for dynamics of Multi-degree freedom systems
CO5	e. Understand the concepts of damping in structures.
Course Outcomes	**SPECIAL CONCRETE - 18CSE15**
C01	Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy
CO2	Acquire and apply fundamental knowledge in the fresh and hardened properties of concrete for special properties.
CO3	Evaluate the effect of the environment on service life performance, properties and failure of structural concrete and demonstrate techniques of measuring the Non Destructive Testing of concrete structure.
CO4	Understand the concepts, mix proportioning and methods of special concreting operations.
Course Outcomes	**Structural engineering lab 1 -18CSEL16**
C01	Achieve Knowledge of design and development of experimenting skills.
CO2	Understand the principles of design of experiments
CO3	Design and develop analytical skills.
CO4	Summarize the testing methods and equipments.
Course Outcomes	**RESEARCH METHODOLOGY AND IPR -18RMI17**
C01	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing

	theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs and their characteristics.
CO4	Explain the art of interpretation and the art of writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR
Course Outcomes	**ADVANCED DESIGN OF STEEL STRUCTURES - 18CSE21**
C01	Able to understand behavior of Light gauge steel members
CO2	Able to understand design concepts of cold formed/unrestrained beams
CO3	Able to understand Fire resistance concept required for present days.
CO4	Able to analyze beam column behavior
Course Outcomes	**Finite element method of analysis - 18CSE22**
C01	Explain the basic theory behind the finite element method.
CO2	Formulate force-displacements relations for 2-D elements
CO3	Use the finite element method to analyze real structures.
CO4	Use a Finite Element based program for structural analysis
Course Outcomes	**EARTHQUAKE RESISTANT STRUCTURES - 18CSE23**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of engineering seismology and concepts of earthquake resistance of reinforced concrete buildings.
CO3	Design and develop analytical skills.
CO4	Summarize the Seismic evaluation and retrofitting of structures.
Course Outcomes	**ADVANCED DESIGN OF PRE- STRESSED CONCRETE STRUCTURES (Elective 1) - 18CSE241**
C01	Analyse , Design and detail PSC elements
Course Outcomes	**STABILITY OF STRUCTURES (Elective 1) - 18CSE242**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of strength and stability
CO3	Design and develop analytical skills.
CO4	Appraise the Stability analysis by finite element approach.
CO5	Understand the concepts of Lateral buckling of beams.
Course Outcomes	**RELIABILITY ANALYSIS OF STRUCTURES (Elective- 1) - 18CSE244**
C01	Understand the concepts of statistics for probabilistic analysis and importance of uncertainty (randomness) in structural analysis and design.
CO2	Apply the theoretical principles of randomness of variables in structural engineering through density functions.
CO3	Analyze components of structure to assess safety using concepts related to structural reliability by various methods.
CO4	Evaluate the safety reliability index at system level.
Course Outcomes	**ADVANCED STRUCTURAL ANALYSIS (Elective 2) - 18CSE251**
C01	Apply Winkler Bach and Strain Energy principles to obtain stresses and deformation in curved members

CO2	Derive the expressions to Foundation pressure, Deflection, Slope, BM and SF of infinite and semi-infinite Beams resting on Elastic Foundation
CO3	Obtain the equations for the shear centre for symmetrical and unsymmetrical from fundamental
CO4	Extrapolate the bending theory to calculate the stresses and deformations in unsymmetrical bending
CO5	Develop the characteristic equation for the buckling load of compound column and stresses and deformations in beam-column
Course Outcomes	**DESIGN OF HIGH RISE STRUCTURES (Elective 2) - 18CSE252**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of strength and stability
CO3	Design and develop analytical skills.
CO4	Summarize the behavior of various structural systems.
CO5	Understand the concepts of P-Delta analysis
Course Outcomes	**DESIGN OF INDUSTRIAL STRUCTURES (Elective 2) - 18CSE253**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the industrial building and the components.
CO3	Design and develop analytical skills
CO4	Summarize the principles of Structural Design and detailing
CO5	Understands the concept of Pre- engineered buildings.
Course Outcomes	**Structural Engineering lab 2 - 18CSEL26**
C01	Achieve Knowledge of design and development of programming skills.
CO2	Understand the principles of structural analysis and design
CO3	Design and develop analytical skills.
Course Outcomes	**DESIGN OF CONCRETE BRIDGES - 18CSE31**
C01	Describe historical growth, select ideal site and bridge, calculate values of design parameters of slab culvert at critical section as per IRC, design and detailing required for the execution of the project.
CO2	Carry out analysis of box culvert as per IRC to obtain the values of design parameters and to design and detail the components following IS code procedure.
CO3	Demonstrate the use of Pigeauds Method and Courbon's Methodin the analysis of T beam bridge as per IRC, design to obtain the safe dimensions various components, optimum reinforcement required following IS code procedure.
CO4	Display the use of Courbon's Methodin the analysis of PSC bridge as per IRC, design to obtain the safe value of pre stressing force, obtain the dimensions of various components to keep the stresses within codal provisions following IS code procedure.
CO 5	Analysis a balanced cantilever bridge as per IRC and to obtain the safe values of design parameters and to design and detail the components as per IS code procedure
Course Outcomes	**DESIGN CONCEPTS OF SUBSTRUCTURES (Elective- 1) - 18CSE321**
C01	Achieve Knowledge of design and development of problem solving skills
CO2	Understand the principles of subsoil exploration
CO3	Design and develop analytical skills.
Course	**REPAIR AND REHABILITATION OF STRUCTURES (Elective -1) - 18CSE322**

Outcomes	
CO4	Identify and evaluate the soil shear strength parameters
C01	Achieve Knowledge of design and development of problem solving skills
CO2	Understand the cause of deterioration of concrete structures
CO3	Design and develop analytical skills
CO4	Summarize the principles of repair and rehabilitation of structures
CO5	Understands the concept of Serviceability and Durability
Course Outcomes	**THEORY OF PLATES AND SHELLS (Elective 1) - 18CSE323**
C01	Achieve Knowledge of design and development of problem solving skills
CO2	Understand the principles of Analysis and Design
CO3	Design and develop analytical skills.
CO4	Summarize the performance of shells
CO5	Understand the concepts of energy principle
Course Outcomes	**FRACTURE MECHANICS APPLIED TO CONCRETE (Elective 2) - 18CSE331**
C01	Apply principles of fracture mechanics.
CO2	Design concrete structures using fracture mechanics approach.
CO3	Explain the importance of fracture mechanics.
CO4	Take special care of very large sized structures
Course Outcomes	**DESIGN OF MASONRY STRUCTURES (Elective 2) - 18CSE332**
C01	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of design and construction of masonry structures
CO3	Design and develop analytical skills
CO4	Summarize the masonry Characteristics
CO5	Evaluate the strength and stability of the masonry structures
Course Outcomes	**COMPOSITE MATERIALS (Elective 2) - 18CSE334**
C01	Define and classify the composite materials.
CO2	Analyze the macro-mechanical behaviour of composites.
CO3	Derive the engineering constants of composites.
CO4	Select the appropriate constituent materials for composite manufacture

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	
COURSE CODE	**20SCS11-MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE**
CO1	Understand the numerical methods to solve and find the roots of the equations..
CO2	Apply the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems
CO3	Understand vector spaces and related topics arising in magnification and rotation of images
CO4	Utilize the statistical tools in multi variable distributions.
C05	Use probability formulations for new predictions with discrete and continuous RV's.
COURSE CODE	**20SCS12- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**
CO1	Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
CO2	Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems
CO3	Demonstrate handling of uncertain knowledge and reasoning in probability theory
CO4	Understanding of Learning methods
COURSE CODE	**20SCS13-ADVANCES IN DATA BASE MANAGEMENT SYSTEM**
CO1	Select the appropriate high-performance database like parallel and distributed database
CO2	Infer and represent the real-world data using object-oriented database
CO3	Interpret rule set in the database to implement data warehousing of mining
CO4	Discover and design database for recent applications database for better interoperability
COURSE CODE	**20SCS14-ADVANCED ALGORITHMS**
CO1	Design and apply iterative and recursive algorithms
CO2	Design and implement optimization algorithms in specific applications.
CO3	Design appropriate shared objects and concurrent objects for applications.
COURSE CODE	**20SCS15-INTERNET OF THINGS AND APPLICATIONS**
CO1	Develop schemes for the applications of IOT in real time scenarios
CO2	Manage the Internet resources
CO3	Model the Internet of things to business
CO4	Understand the practical knowledge through different case studies
CO5	Understand data sets received through IoT devices and tools used for analysis

COURSE CODE	20SCSL16-ALGORITHMS AND DATABASE MANAGEMENT SYSTEMS LABORATORY
CO1	Work on the concepts of Software Testing and ADBMS at the practical level
CO2	Compare and pick out the right type of software testing process for any given real-world problem
CO3	Carry out the software testing process in efficient way
CO4	Establish a quality environment as specified in standards for developing quality software
CO5	Model and represent the real-world data using object-oriented database
CO6	Embed the rules set in the database to implement various features of ADBMS
CO7	Choose, design and implement recent applications database for better interoperability
COURSE CODE	20RMI17-RESEARCH METHODOLOGY AND IPR
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.
COURSE CODE	20SCS21-DATA SCIENCE
CO1	Define data science and its fundamentals
CO2	Demonstrate the process in data science
CO3	Explain machine learning algorithms necessary for data sciences
CO4	Illustrate the process of feature selection and analysis of data analysis algorithms
CO5	Visualize the data and follow of ethics
COURSE CODE	20SCS22-SEMANTIC WEB AND SOCIAL NETWORKS
CO1	Demonstrate the semantic web technologies like RDF Ontology and others
CO2	Learn the various semantic web applications
CO3	Identify the architectures and challenges in building social networks
CO4	Analyse the performance of social networks using electronic sources
COURSE CODE	20SCS23-BLOCKCHAIN TECHNOLOGY
CO1	Understand the types, benefits and limitation of blockchain
CO2	Explore the blockchain decentralization and cryptography concepts
CO3	Enumerate the Bitcoin features and its alternative options.
CO4	Describe and deploy the smart contracts
CO5	Summarize the blockchain features outside of currencies.

COURSE CODE	20SCS241-ADVANCED CRYPTOGRAPHY
CO1	Understand OSI security architecture and classical encryption techniques
CO2	Acquire fundamental knowledge on the concepts of finite fields and number theory
CO3	Understand various block cipher and stream cipher models.
CO4	Describe the principles of public key cryptosystems, hash functions and digital signature
CO5	Compare various Cryptographic Techniques
CO6	Design Secure applications
CO7	Inject secure coding in the developed applications
COURSE CODE	20SCS242-NATURAL LANGUAGE PROCESSING
CO1	Analyse the natural language text
CO2	Generate the natural language.
CO3	Demonstrate Text mining.
CO4	Apply information retrieval techniques.
COURSE CODE	20SCS24-CLOUD COMPUTING
CO1	Compare the strengths and limitations of cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Apply suitable virtualization concept.
CO4	Choose the appropriate cloud player
CO5	Address the core issues of cloud computing such as security, privacy and interoperability
CO6	Design Cloud Services
CO7	Set a private cloud
COURSE CODE	20SCS244-PATTERN RECOGNITION
CO1	Explain pattern recognition principals
CO2	Develop algorithms for Pattern Recognition
CO3	Develop and analyse decision tress
CO4	Design the nearest neighbour classifier
CO5	Apply Decision tree and clustering techniques to various applications
COURSE CODE	20SCS251-IMAGE PROCESSING AND MACHINE VISION
CO1	Explain the fundamentals of image processing and computer vision
CO2	Illustrate the image enhancement techniques
CO3	Illustrate Image restoration and image compression technique
CO4	Tell about image segmentation and morphological image processing
CO5	Summarize computer vision techniques and its uses

COURSE CODE	20SCS252-OBJECT ORIENTED DESIGN
CO1	Identify the heuristics of the object-oriented programming
CO2	Explain the fundamentals of OOP
CO3	Examine fine object-oriented relations
CO4	Explain the role of Physical Object-Oriented Design
CO5	Make use of Heuristics in The Use of Heuristics in Object-Oriented Design
COURSE CODE	20SCS253-SOFTWARE DEFINED NETWORKS
CO1	Explain the fundamentals of SDN and make use of open flow tool
CO2	Illustrate the concepts of controllers and network programmability
CO3	Explain data centre and NFV
CO4	Build an SDN framework
CO5	Report use case
COURSE CODE	20SCS254-MODERN COMPUTER ARCHITECTURE
CO1	Explain the fundamentals of Fundamentals of Computer Design, Pipelining, ILP
CO2	Summarize the concept of memory
CO3	Abstracting the concept of parallelism
CO4	Summarize the hardware technologies
CO5	Outlineparallel and scalable architectures
COURSE CODE	20SCSL26-DATA SCIENCE LABORATORY
CO1	Demonstration of data visualization methods
CO2	Understanding and implementation of data science algorithms
COURSE CODE	20SCS27-TECHNICAL SEMINAR
CO1	Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization
CO2	Carryout literature survey, organize the Course topics in a systematic order.
CO3	Prepare the report with own sentences.
CO4	Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities
CO5	Present the seminar topic orally and/or through power point slides.
CO6	Answer the queries and involve in debate/discussion.
CO7	Submit two copies of the typed report with a list of references

COURSE CODE	20SCS31-DEEP LEARNING
CO1	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
CO2	Implement deep learning algorithms and solve real-world problems.
CO3	Execute performance metrics of Deep Learning Techniques.
	20SCS321-ENGINEERING ECONOMICS
CO1	Describe the principles of economics that govern the operation of any organization under diverse market conditions
CO2	Comprehend macroeconomic principles and decision making in diverse business set up
CO3	Explain the Inflation & Price Change as well as Present Worth Analysis
CO4	Apply the principles of economics through various case studies
COURSE CODE	20SCS322-VIRTUAL REALITY
CO1	Explain fundamentals of virtual reality systems
CO2	Summarize the hardware and software of the VR
CO3	Analyse the applications of VR
COURSE CODE	20SCS322-SOFT AND EVOLUTIONARY COMPUTING
CO1	Implement machine learning through neural networks
CO2	Design Genetic Algorithm to solve the optimization problem.
CO3	Develop a Fuzzy expert system.
CO4	Model Neuro Fuzzy system for clustering and classification
COURSE CODE	20SCS324-MULTICORE ARCHITECTURE AND PROGRAMMING
CO1	Identify the limitations of single core architecture and the need for multicore architectures
CO2	Define fundamental concepts of parallel programming and its design issues
CO3	Solve the issues related to multiprocessing and suggest solutions
CO4	Demonstrate the role of OpenMP and programming concept
CO5	Make out the salient features of different multicore architectures and how they exploit parallelism
COURSE CODE	20SCS331-BUSINESS INTELLIGENCE AND ITS APPLICATIONS
CO1	Explain the complete life cycle of BI/Analytical development
CO2	Illustrate technology and processes associated with Business Intelligence framework
CO3	Demonstrate a business scenario, identify the metrics, indicators and make recommendations to achieve the business goal.
COURSE CODE	20SCS332-ROBOTICS AND AUTOMATION
CO1	Classify various types of automation & manufacturing systems
CO2	Discuss different robot configurations, motions, drive systems and its performance parameters
CO3	Describe the basic concepts of control systems, feedback components, actuators and power transmission systems used in robots.

CO4	Explain the working of transducers, sensors and machine vision systems
CO5	Discuss the future capabilities of sensors, mobility systems and Artificial Intelligence in the field of robotics
COURSE CODE	**20SCS333-SPEECH PROCESSING**
CO1	Explain the fundamentals of speech processing
CO2	Summarize the models of speech processing
CO3	Infer the linear predictive coding
CO4	Illustrate the application of speech processing
COURSE CODE	**20SCS334-WIRELESS SENSOR NETWORKS**
CO1	Know the basics , characteristics and challenges of Wireless Sensor Network
CO2	Apply the knowledge to identify appropriate physical and MAC layer protocol
CO3	Apply the knowledge to identify the suitable routing algorithm based on the network and user requirement
CO4	Be familiar with the OS used in Wireless Sensor Networks and build basic modules
CO5	Understand the applications of WSN in various fields
COURSE CODE	**20SCS34-PROJECT WORK PHASE – 1**
CO1	Demonstrate a sound technical knowledge of their selected project topic
CO2	Undertake problem identification, formulation, and solution
CO3	Design engineering solutions to complex problems utilising a systems approach
CO4	Communicate with engineers and the community at large in written an oral forms
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer
COURSE CODE	**20SCS35-MINI PROJECT**
CO1	Present the mini-project and be able to defend it
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills.
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.
COURSE CODE	**20SCSI36-INTERNSHIP / PROFESSIONAL PRACTICE**
CO1	Gain practical experience within industry in which the internship is done
CO2	Acquire knowledge of the industry in which the internship is done.
CO3	Apply knowledge and skills learned to classroom wor
CO4	Develop a greater understanding about career options while more clearly defining personal career goals
CO5	Experience the activities and functions of professionals.
CO6	Develop and refine oral and written communication skills

CO7	Identify areas for future knowledge and skill development.
CO8	Expand intellectual capacity, credibility, judgment, intuition
CO9	Acquire the knowledge of administration, marketing, finance and economics.
COURSE CODE	**20SCS41-PROJECT WORK PHASE -2**
CO1	Present the project and be able to defend it
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING	
COURSE CODE	18CPS13/23-C PROGRAMMING FOR PROBLEM SOLVING
CO1	Illustrate simple algorithms from the different domains such as mathematics, physics etc
CO2	construct programming solution to the given problem using C
CO3	Identify and correct the syntax and logical errors in C programs
CO4	Modularise the given problems using functions and structures.
COURSE CODE	18CPS17/27-C PROGRAMMING LABORATORY
CO1	Write Algorithms, flowchats, programs for simple problems
CO2	Correct Syntax and logical errors to execute a program
CO3	write irerative and wherever possible recursive programs
CO4	Demonstrate use of functions, arrays, strings, structures and pointers in problem solving
COURSE CODE	18CS32-DATA STRUCTURES AND APPLICATIONS
CO1	Use different types of data structures, operations and algorithms
CO2	Apply searching and sorting operations on files
CO3	Use stack, Queue, Lists, Trees and Graphs in problem solving
CO4	Implement all data structures in a high-level language for problem solving.
COURSE CODE	18CS33-ANALOG AND DIGITAL ELECTRONICS
CO1	Design and analyze application of analog circuits using photo devices, timer IC, power supply and regulator IC and op-amp.
CO2	Explain the basic principles of A/D and D/A conversion circuits and develop the same.
CO3	Simplify digital circuits using Karnaugh Map , and Quine-McClusky Methods
CO4	Explain Gates and flip flops and make us in designing different data processing circuits, registers and counters and compare the types.
CO5	Develop simple HDL programs
COURSE CODE	18CS34-COMPUTER ORGANIZATION
CO1	Explain the basic organization of a computer system.
CO2	Demonstrate functioning of different sub systems, such as processor, Input/output,and memory. Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems.
CO3	Design and analyse simple arithmetic and logical units.
COURSE CODE	18CS35-SOFTWARE ENGINEERING
CO1	Design a software system, component, or process to meet desired needs within realistic constraints.
CO2	Assess professional and ethical responsibility
CO3	Function on multi-disciplinary teams
CO4	Use the techniques, skills, and modern engineering tools necessary for engineering practice
CO5	Analyze, design, implement, verify, validate, implement, apply, and maintain software systems or parts of software systems

COURSE CODE	18CS36-DISCRETE MATHEMATICAL STRUCTURES
CO1	Use propositional and predicate logic in knowledge representation and truth verification.
CO2	Demonstrate the application of discrete structures in different fields of computer science.
CO3	Solve problems using recurrence relations and generating functions.
CO4	Application of different mathematical proofs techniques in proving theorems in the courses.
CO5	Compare graphs, trees and their applications.
COURSE CODE	18CSL37-ANALOG AND DIGITAL ELECTRONICS LABORATORY
CO1	Use appropriate design equations / methods to design the given circuit.
CO2	Examine and verify the design of both analog and digital circuits using simulators.
CO3	Make us of electronic components, ICs, instruments and tools for design and testing of circuits for the given the appropriate inputs.
CO4	Compile a laboratory journal which includes; aim, tool/instruments/software/components used, design equations used and designs, schematics, program listing, procedure followed, relevant theory, results as graphs and tables, interpreting and concluding the findings.
COURSE CODE	18CSL38-DATA STRUCTURES LABORATORY
CO1	Analyze and Compare various linear and non-linear data structures
CO2	Code, debug and demonstrate the working nature of different types of data structures and their applications
CO3	Implement, analyze and evaluate the searching and sorting algorithms
CO4	Choose the appropriate data structure for solving real world problems
COURSE CODE	18CS42-DESIGN AND ANALYSIS OF ALGORITHMS
CO1	Describe computational solution to well-known problems like searching, sorting etc.
CO2	Estimate the computational complexity of different algorithms.
CO3	Devise an algorithm using appropriate design strategies for problem solving.
COURSE CODE	18CS43-OPERATING SYSTEMS
CO1	Demonstrate need for OS and different types of OS
CO2	Apply suitable techniques for management of different resources
CO3	Use processor, memory, storage and file system commands
CO4	Realize the different concepts of OS in platform of usage through case studies
COURSE CODE	18CS44-MICROCONTROLLER AND EMBEDDED SYSTEMS
CO1	Describe the architectural features and instructions of ARM microcontroller
CO2	Apply the knowledge gained for Programming ARM for different applications.
CO3	Interface external devices and I/O with ARM microcontroller.
CO4	Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
CO5	Develop the hardware /software co-design and firmware design approaches.
CO6	Demonstrate the need of real time operating system for embedded system applications
COURSE CODE	18CS45-OBJECT ORIENTED CONCEPTS
CO1	Explain the object-oriented concepts and JAVA.
CO2	Develop computer programs to solve real world problems in Java.

CO3	Develop simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles using swings.
COURSE CODE	18CS46-DATA COMMUNICATION
CO1	Explain the various components of data communication.
CO2	Explain the fundamentals of digital communication and switching.
CO3	Compare and contrast data link layer protocols.
CO4	Summarize IEEE 802.xx standards
COURSE CODE	18CSL47-DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY
CO1	Design algorithms using appropriate design techniques (brute-force, greedy, dynamic programming, etc.)
CO2	Implement a variety of algorithms such assorting, graph related, combinatorial, etc., in a high level language.
CO3	Analyze and compare the performance of algorithms using language features.
CO4	Apply and implement learned algorithm design techniques and data structuresto solve real-world problems
COURSE CODE	18CSL48-MICROCONTROLLER AND EMBEDDED SYSTEMS LABORATORY
CO1	Develop and test program using ARM7TDMI/LPC2148
CO2	Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' & Keil Uvision-4 tool/compiler.
COURSE CODE	18CS51-MANAGEMENT AND ENTREPRENEURSHIP FOR IT INDUSTRY
CO1	Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship
CO2	Utilize the resources available effectively through ERP
CO3	Make use of IPRs and institutional support in entrepreneurship
COURSE CODE	18CS52-COMPUTER NETWORKS AND SECURITY
CO1	Explain principles of application layer protocols
CO2	Recognize transport layer services and infer UDP and TCP protocols
CO3	Classify routers, IP and Routing Algorithms in network layer
CO4	Understand the Wireless and Mobile Networks covering IEEE 802.11 Standard
CO5	Describe Multimedia Networking and Network Management
COURSE CODE	18CS53-DATABASE MANAGEMENT SYSTEM
CO1	Identify, analyze and define database objects, enforce integrity constraints on a database using RDBMS.
CO2	Use Structured Query Language (SQL) for database manipulation.
CO3	Design and build simple database systems
CO4	Develop application to interact with databases
COURSE CODE	18CS54-AUTOMATA THEORY AND COMPUTABILITY
CO1	Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation
CO2	Learn how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).
CO3	Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.
CO4	Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness.
CO5	Classify a problem with respect to different models of Computation.

COURSE CODE	18CS55-APPLICATION DEVELOPMENT USING PYTHON
CO1	Demonstrate proficiency in handling of loops and creation of functions.
CO2	Identify the methods to create and manipulate lists, tuples and dictionaries.
CO3	Discover the commonly used operations involving regular expressions and file system.
CO4	Interpret the concepts of Object-Oriented Programming as used in Python.
CO5	Determine the need for scraping websites and working with CSV, JSON and other file formats.
COURSE CODE	18CS56-UNIX PROGRAMMING
CO1	Explain Unix Architecture, File system and use of Basic Commands
CO2	Illustrate Shell Programming and to write Shell Scripts
CO3	Categorize, compare and make use of Unix System Calls
CO4	Build an application/service over a Unix system.
COURSE CODE	18CSL57-COMPUTER NETWORK LABORATORY
CO1	Analyze and Compare various networking protocols.
CO2	Demonstrate the working of different concepts of networking.
CO3	Implement, analyze and evaluate networking protocols in NS2 / NS3 and JAVA programming language
COURSE CODE	18CSL58-DBMS LABORATORY WITH MINI PROJECT
CO1	Create, Update and query on the database.
CO2	Demonstrate the working of different concepts of DBMS
CO3	Implement, analyze and evaluate the project developed for an application.
COURSE CODE	18CIV59-ENVIRONMENTAL STUDIES
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
COURSE CODE	18CS61-SYSTEM SOFTWARE AND COMPILERS
CO1	Explain system software
CO2	Design and develop lexical analyzers, parsers and code generators
CO3	Utilize lex and yacc tools for implementing different concepts of system software
COURSE CODE	18CS62-COMUTER GRAPHICS AND VISUALIZATION
CO1	Design and implement algorithms for 2D graphics primitives and attributes.
CO2	Illustrate Geometric transformations on both 2D and 3D objects.
CO3	Apply concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models.
CO4	Decide suitable hardware and software for developing graphics packages using OpenGL.
COURSE CODE	18CS63-WEB TECHNOLOGY AND ITS APPLICATIONS
CO1	Adapt HTML and CSS syntax and semantics to build web pages.
CO2	Construct and visually format tables and forms using HTML and CSS

CO3	Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.
CO4	Appraise the principles of object oriented development using PHP
CO5	Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.
COURSE CODE	18CS642-OBJECT ORIENTED MODELING AND DESIGN
CO1	Describe the concepts of object-oriented and basic class modelling.
CO2	Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
CO3	Choose and apply a befitting design pattern for the given problem
COURSE CODE	18EE653-RENEWABLE ENERGY RESOURCES
CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO5	Discuss production of energy from biomass, biogas.
CO6	Summarize tidal energy resources, sea wave energy and ocean thermal energy.
COURSE CODE	18CSL66-SYSTEM SOFTWARE LABORATORY
CO1	Implement and demonstrate Lexer‟s and Parser‟s
CO2	Evaluate different algorithms required for management, scheduling, allocation and communication used in operating system.
COURSE CODE	18CSL67-COMPUTER GRAPHICS LABORATORY WITH MINI PROJECT
CO1	Apply the concepts of computer graphics
CO2	Implement computer graphics applications using OpenGL
CO3	Animate real world problems using OpenGL
COURSE CODE	18CSMP68-MOBILE APPLICATION DEVELOPMENT
CO1	Create, test and debug Android application by setting up Android development environment.
CO2	Implement adaptive, responsive user interfaces that work across a wide range of devices.
CO3	Infer long running tasks and background work in Android applications.
CO4	Demonstrate methods in storing, sharing and retrieving data in Android applications.
COURSE CODE	18CS71-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
CO1	Appaise the theory of Artificial intelligence and Machine Learning.
CO2	Illustrate the working of AI and ML Algorithms.
CO3	Demonstrate the applications of AI and ML.
COURSE CODE	18CS72-BIG DATA AND ANALYTICS
CO1	Understand fundamentals of Big Data analytics.
CO2	Investigate Hadoop framework and Hadoop Distributed File system.
CO3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
CO4	Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.

CO5	Use Machine Learning algorithms for real world big data.
CO6	Analyze web contents and Social Networks to provide analytics with relevant visualization tools.
COURSE CODE	18CS733-ADVANCED COMPUTER ARCHITECTURES
CO1	Explain the concepts of parallel computing and hardware technologies
CO2	Compare and contrast the parallel architectures
CO3	Illustrate parallel programming concepts
COURSE CODE	18CS742-NETWORK MANAGEMENT
CO1	Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
CO2	Apply network management standards to manage practical networks
CO3	Formulate possible approaches for managing OSI network model.
CO4	Use on SNMP for managing the network
CO5	Use RMON for monitoring the behavior of the network
CO6	Identify the various components of network and formulate the scheme for the managing them
COURSE CODE	18EE753-DISASTER MANAGEMENT
CO1	Discuss disaster management plan, cyclones and their hazard potential
CO2	Understand the role of IMD and cyclone prediction and cyclone warning system in India
CO3	Understand the role of different institutions defence and other services in natural disaster management.
CO4	Understand the role of Central Water Commission in river water sharing, Draught, its assessment and draught management plan
COURSE CODE	18CSL76-ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LABORATORY
CO1	Implement and demonstrate AI and ML algorithms.
CO2	Evaluate different algorithms.
COURSE CODE	18CS81-INTERNET OF THINGS
CO1	Interpret the impact and challenges posed by IoT networks leading to new architectural models.
CO2	Compare and contrast the deployment of smart objects and the technologies to connect them to network.
CO3	Appraise the role of IoT protocols for efficient network communication.
CO4	Elaborate the need for Data Analytics and Security in IoT.
CO5	Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry
COURSE CODE	18CS823-NOSQL DATABASE
CO1	Define, compare and use the four types of NoSQL Databases (Document-oriented, KeyValue Pairs, Column-oriented and Graph).
CO2	Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
CO3	Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.

PG-B.E (CS) 2018-Scheme COs	
COURSE CODE	18SCS11-MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE
CO1	Understand the numerical methods to solve and find the roots of the equations.
CO2	Utilize the statistical tools in multi variable distributions.
CO3	Use probability formulations for new predictions with discrete and continuous RV's.
CO4	To understand various graphs in different geometries related to edges.
CO5	Understand vector spaces and related topics arising in magnification and rotation of images.
COURSE CODE	18SCS12-ADVANCES IN OPERATING SYSTEMS
CO1	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
CO2	Learn the various resource management techniques for distributed systems
CO3	Identify the different features of real time and mobile operating system
CO4	Modify existing open source kernels in terms of functionality or features used
COURSE CODE	18SCS13-ADVANCES IN DATA BASE MANAGEMENT SYSTEMS
CO1	Select the appropriate high performance database like parallel and distributed database
CO2	Infer and represent the real world data using object oriented database
CO3	Interpret rule set in the database to implement data warehousing of mining
CO4	Discover and design database for recent applications database for better interoperability
COURSE CODE	18SCS14-INTERNET OF THINGS
CO1	Develop schemes for the applications of IOT in real time scenarios
CO2	Manage the Internet resources
CO3	Model the Internet of things to business
CO4	Understand the practical knowledge through different case studies
CO5	Understand data sets received through IoT devices and tools used for analysis
COURSE CODE	18SCS151-ADVANCES IN COMPUTER NETWORKS
CO1	List and classify network services, protocols and architectures, explain why they are layered.
CO2	Choose key Internet applications and their protocols, and apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
CO3	Explain develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.
CO4	Explain various congestion control techniques.
COURSE CODE	18SCSL16-ADBMS AND IOT LABORATORY
CO1	Work on the concepts of Software Testing and ADBMS at the practical level
CO2	Compare and pick out the right type of software testing process for any given real world problem
CO3	Carry out the software testing process in efficient way
CO4	Establish a quality environment as specified in standards for developing quality software
CO5	Model and represent the real world data using object oriented database
CO6	Embed the rules set in the database to implement various features of ADBMS

CO7	Choose, design and implement recent applications database for better interoperability
COURSE CODE	18SCS21-MANAGING BIG DATA
CO1	Describe big data and use cases from selected business domains
CO2	Explain NoSQL big data management
CO3	Install, configure, and run Hadoop and HDFS
CO4	Perform map-reduce analytics using Hadoop
CO5	Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data Analytics
COURSE CODE	18SCS22-ADVANCED ALGORITHMS
CO1	Design and apply iterative and recursive algorithms.
CO2	Design and implement optimization algorithms in specific applications.
CO3	Design appropriate shared objects and concurrent objects for applications
COURSE CODE	18SCS23-CLOUD COMPUTING
CO1	Compare the strengths and limitations of cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing
CO3	Apply suitable virtualization concept.
CO4	Choose the appropriate cloud player
CO5	Address the core issues of cloud computing such as security, privacy and interoperability
CO6	Design Cloud Services
CO7	Set a private cloud
COURSE CODE	18SCS241-ADVANCES IN STORAGE AREA NETWORKS
CO1	Identify the need for performance evaluation and the metrics used for it
CO2	Apply the techniques used for data maintenance.
CO3	Realize strong virtualization concepts
CO4	Develop techniques for evaluating policies for LUN masking, file systems
COURSE CODE	18SCS253-OBJECT ORIENTED SOFTWARE ENGINEERING
CO1	Apply Object Oriented Software Engineering approach in every aspect of software project
CO2	Analyze the requirements from various domains
CO3	Adapt appropriate object oriented design aspects in the development process
CO4	Implement and test the software projects using object oriented approach
CO5	Learn the issues and concepts relating to maintenance of software projects
CO6	Adapt the concepts and tools related to software configuration management
COURSE CODE	18SCS31-MACHINE LEARNING TECHNIQUES
CO1	Choose the learning techniques with this basic knowledge.
CO2	Apply effectively neural networks and genetic algorithms for appropriate applications.
CO3	Apply bayesian techniques and derive effectively learning rules.
CO4	Choose and differentiate reinforcement and analytical learning techniques
COURSE CODE	18SCS323-WIRELESS NETWORKS AND MOBILE COMPUTING
CO1	Explain state of art techniques in wireless communication.
CO2	Discover CDMA, GSM. Mobile IP, WImax
CO3	Demonstrate program for CLDC, MIDP let model and security concerns

COURSE CODE	18SCS332-SOFTWARE PROJECT PLANNING AND MANAGEMENT
CO1	Evaluate a project to develop the scope of work, provide accurate cost estimates and to plan the various activities
CO2	Apply risk management analysis techniques that identify the factors that put a project at risk and to quantify the likely effect of risk on project timescales
CO3	Identify the resources required for a project and to produce a work plan and resource schedule
CO4	Monitor the progress of a project and to assess the risk of slippage, revising targets counteract drift
CO5	Use appropriate metrics to management the software development outcome
CO6	Develop research methods and techniques appropriate to defining, planning and carrying out a research project within your chosen specialist area within the management of software projects.

PROGRAMME OUTCOME, PROGRAMMESPECIFIC OUTCOMES AND COURSEOUTCOMES OF ALL DEPARTMENTS–2020-21(CRITERIA- 2)

2.6.1 Program outcomes, program specific outcomes and course outcomes

Department of Electronics & Communication Engineering

Program Outcomes (PO's)

PO 1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 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.

PO 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.

PO 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.

PO 5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 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.

PO 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.

PO 12: Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO's)

PSO 1: Analyse and Design Electronic Systems for Signal Processing and Communication Applications.

PSO 2: Demonstrate the Conceptual Domain Knowledge With Respect to Architecture, Design, Analysis and Engineering deployment in Data Communication and Computer Networking. Embedded system. Microcontroller, Advanced communication system.

PSO 3: Identify and Apply Domain Specific Tools For Design, Analysis, Synthesis and Validation Of VLSI, Optical Fiber Communication and Communication Systems.

ELECTRONICS AND COMMUNICATION ENGINEERING 2021-Scheme	
Course Code	**21ELN14/24 - BASIC ELECTRONICS & COMMUNICATION ENGINEERING**
CO1	Describe the concepts of electronic circuits encompassing power supplies, amplifiers and oscillators
CO2	Present the basics of digital logic engineering including data representation, circuits and the microcontroller system with associated sensors and actuators.
CO3	Discuss the characteristics and technological advances of embedded systems.
CO4	Relate to the fundamentals of communication engineering spanning from the frequency spectrum to the various circuits involved including antennas.
CO5	Explain the different modes of communications from wired to wireless and the computing involved
Course Code	**21MAT 31 - TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICALTECHNIQUES**
CO1	To solve ordinary differential equations using Laplace transform
CO2	Demonstrate the Fourier series to study the behaviour of periodic functions and their applicationsin system communications, digital signal processing and field theory
CO3	To use Fourier transforms to analyze problems involving continuous-time signals and to apply ZTransform techniques to solve difference equations
CO4	To solve mathematical models represented by initial or boundary value problems involving partial differential equations
CO5	Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
Course Code	**21EC32 - Digital System Design Using Verilog**
CO1	Simplify Boolean functions using K-map and Quine-McCluskey minimization technique
CO2	Analyze and design for combinational logic circuits
CO3	Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequentialcircuits using Flip Flops.
CO4	Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions.
Course Code	**21EC33 - Basic Signal Processing**
CO1	Understand the basics of Linear Algebra
CO2	Analyse different types of signals and systems
CO3	Analyse the properties of discrete time signals & systems
CO4	Analyse discrete time signals & systems using Z transforms
Course Code	**21EC34 - Analog Electronic Circuits**
CO1	Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
CO2	Design and analyze FET amplifiers and oscillators with different circuit configurations and biasing conditions.
CO3	Understand the feedback topologies and approximations in the design of amplifiers and oscillators
CO4	Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers
CO5	Understand the power electronic device components and its functions for basic power electronic circuits.
Course Code	**21ECL35 - Analog and Digital Electronics Lab**
CO1	Design and analyze the BJT/FET amplifier and oscillator circuits

CO2	Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers.
CO3	Design and test the combinational logic circuits for the given specifications
CO4	Test the sequential logic circuits for the given functionality
CO5	Demonstrate the basic electronic circuit experiments using SCR and 555 timer.
Course Code	**21EC382 - AEC (Analog Electronic Circuits) Lab**
CO1	Understand the circuit schematic and its working
CO2	Study the characteristics of different electronic devices
CO3	Design and test simple electronic circuits as per the specifications using discrete electronic components.
CO4	Compute the parameters from the characteristics of active devices.
CO5	Familiarize with EDA software which can be used for electronic circuit simulation.
Course Code	**21EC41 - Maths for Communication Engineers**
CO1	Recall the basic laws and definitions (with mathematical representations) in Electric and Magnetic fields.
CO2	Apply the basic laws of Electric and Magnetic fields to arrive at Divergence Theorem, Current continuity Equation, Curl, Stokes' theorem
CO3	Apply Electric and Magnetic field concepts to arrive at Maxwell's equations, Electromagnetic wave equations and Poynting's theorem (Important concepts related to Communication link).
CO4	Recall the definitions related to Random variables and Random Processes
CO5	Model the Random events in the Communication set-up and determine useful statistical parameters.
Course Code	**21EC42 - Digital Signal Processing**
CO1	Determine response of LTI systems using time domain and DFT techniques
CO2	Compute DFT of real and complex discrete time signals
CO3	Compute DFT using FFT algorithms
CO4	Design FIR and IIR Digital Filters
CO5	Design of Digital Filters using DSP processor
Course Code	**21EC43- Circuits & Controls**
CO1	Analyse and solve Electric circuit, by applying, loop analysis, Nodal analysis and by applying network Theorems.
CO2	Evaluate two port parameters of a network and Apply Laplace transforms to solve electricnetworks
CO3	Deduce transfer function of a given physical system, from differential equation representation or Block Diagram representation and SFG representation
CO4	Calculate time response specifications and analyse the stability of the system
CO5	Draw and analyse the effect of gain on system behaviour using root loci.
CO6	Perform frequency response Analysis and find the stability of the system
CO7	Represent State model of the system and find the time response of the system.
Course Code	**21EC44 - Communication Theory**
CO1	Understand the amplitude and frequency modulation techniques and perform time and frequency domain transformations
CO2	Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance
CO3	Characterize the influence of channel noise on analog modulated signals
CO4	Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems

CO5	Illustration of digital formatting representations used for Multiplexers, Vocoders and Videotransmission.
Course Code	**21ECL46 - Communication Laboratory I**
CO1	Demonstrate the AM and FM modulation and demodulation by representing the signals in time and frequency domain.
CO2	Design and test the sampling, Multiplexing and PAM with relevant circuits
CO3	Demonstrate the basic circuitry and operations used in AM and FM receivers
CO4	Illustrate the operation of PCM and delta modulations for different input conditions
Course Code	**21EC482- C++ Basics**
CO1	Write C++ program to solve simple and complex problems
CO2	Apply and implement major object-oriented concepts like message passing, function overloading, operator overloading and inheritance to solve real-world problems
CO3	Use major C++ features such as Templates for data type independent designs and File I/O to deal with large data set
CO4	Analyze, design and develop solutions to real-world problems applying OOP concepts of C++
Course Code	**21EC51 - Digital Communication**
CO1	Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications
CO2	Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels
CO3	Differentiate various spread spectrum schemes and compute the performance parameters of communication system.
CO4	Apply the fundamentals of information theory and perform source coding for given message
CO5	Apply different encoding and decoding techniques with error Detection and Correction
Course Code	**21EC52 - Computer Organization & ARM Microcontrollers**
CO1	Explain the basic organization of a computer system
CO2	Demonstrate functioning of different sub systems, such as processor, Input/output, and memory
CO3	Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3
CO4	Apply the knowledge gained for Programming ARM Cortex M3 for different applications.
Course Code	**21EC53 - Computer Communication Networks**
CO1	Understand the concepts of networking thoroughly
CO2	Identify the protocols and services of different layers
CO3	Distinguish the basic network configurations and standards associated with each network.
CO4	Discuss and analyse the various applications that can be implemented on networks
Course Code	**21EC54 - ELECTROMAGNETIC WAVES**
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume
CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem
CO3	Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations
CO4	Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials

	and voltage induced in electric circuits.
CO5	Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem
Course Code	**21ECL55 - Communication Lab II**
CO1	Design and test the digital modulation circuits and display the waveforms
CO2	To Implement the source coding algorithm using C/C++/ MATLAB code
CO3	To Implement the Error Control coding algorithms using C/C++/ MATLAB code.
CO4	Illustrate the operations of networking concepts and protocols using C programming and network simulators.
Course Code	**21EC581 - IoT (Internet of Things) Lab**
CO1	Understand internet of Things and its hardware and software components
CO2	Interface I/O devices, sensors & communication modules
CO3	Remotely monitor data and control devices
CO4	Develop real life IoT based projects
Course Code	**21EC62 - Microwave Theory and Antennas**
CO1	Describe the use and advantages of microwave transmission
CO2	Analyze various parameters related to transmission lines.
CO3	Identify microwave devices for several applications
CO4	Analyze various antenna parameters and their significance in building the RF system
CO5	Identify various antenna configurations for suitable applications
Course Code	**21EC63- VLSI Design and Testing**
CO1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling
CO2	Draw the basic gates using the stick and layout diagram with the knowledge of physical design aspects
CO3	Interpret memory elements along with timing considerations
CO4	Interpret testing and testability issues in combinational logic design
CO5	Interpret testing and testability issues in combinational logic design
Course Code	**21EC643 - Python Programming**
CO1	To acquire programming skills in Python
CO2	To demonstrate data structure representation using Python
CO3	To develop the skill of pattern matching and files in Python
CO4	To acquire Object Oriented Skills in Python
CO5	To develop the ability to write database applications in Python
Course Code	**21EC653 - Basic VLSI Design**
CO1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling
CO2	Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects
CO3	Interpret Memory elements along with timing considerations
CO4	Demonstrate knowledge of FPGA based system design
CO5	Interpret testing and testability issues in VLSI Design
CO6	Analyze CMOS subsystems and architectural issues with the design constraints
Course Code	**21ECL66 - VLSI Laboratory**
CO1	Design and simulate combinational and sequential digital circuits using Verilog HDL.
CO2	Understand the synthesis process of digital circuits using EDA tool
CO3	Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.

CO4	Design and simulate basic CMOS circuits like inverter, common source amplifier, differential amplifier, SRAM
CO5	Perform RTL_GDSII flow and understand the stages in ASIC design
Course Code	**21EC71 - Advanced VLSI**
CO1	Understand VLSI design flow
CO2	Describe the concepts of ASIC design methodology
CO3	Create floor plan including partition and routing with the use of CAD algorithms
CO4	Will have better insights into VLSI back-end design flow
CO5	Learn verification basics and System Verilog
Course Code	**21EC72 - Optical & Wireless Communication**
CO1	Classification and characterization of optical fibers with different modes of signal propagation
CO2	Describe the constructional features and the characteristics of optical fiber and optical devices used for signal transmission and reception
CO3	Understand the essential concepts and principles of mobile radio channel and cellular communication.
CO4	Describe various multiple access techniques used in wireless communication systems
CO5	Describe the GSM architecture and procedures to establish call set up, call progress handling and call tear down in a GSM cellular network.
Course Code	**21EC722 – Digital Image Processing**
CO1	Understand image formation and the role of human visual system plays in perception of gray and color image data
CO2	Compute various transforms on digital images
CO3	Conduct independent study and analysis of Image Enhancement techniques
CO4	Apply image processing techniques in frequency (Fourier) domain
CO5	Design image restoration techniques
Course Code	**21EC732 – Network Security**
CO1	Explain network security services and mechanisms and explain security concepts
CO2	Understand the concept of Transport Level Security and Secure Socket Layer
CO3	Explain Security concerns in Internet Protocol security
CO4	Explain Intruders, Intrusion detection and Malicious Software
CO5	Describe Firewalls, Firewall Characteristics, Biasing and Configuration
Course Code	**21CS744 - ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT**
CO1	To Understand the basic concepts of RPA
CO2	To Describe various components and platforms of RPA
CO3	To Describe the different types of variables, control flow and data manipulation techniques
CO4	To Understand various control techniques and OCR in RPA
CO5	To Describe various types and strategies to handle exceptions

ELECTRONICS AND COMMUNICATION ENGINEERING 2018 Scheme	
Course Code	**18ELN14/24 - BASIC ELECTRONICS**
CO1	Describe the operation of diodes, BJT, FET and operational amplifiers
CO2	Design and explain the construction of rectifiers, regulators, amplifiers and oscillators.
CO3	Describe general operating principles of SCRs and its application.
CO4	Explain the working and design of fixed voltage regulator using 7805 and Astable oscillator using timer IC 555.
CO5	Explain the different number system and their conversions and construct simple combinational and sequential logic circuits using Flip-Flops
CO6	Describe the basic principle of operation of communication system and mobile phones.
Course Code	**18EC32 - NETWORK THEORY**
CO1	Determine currents and voltages using source transformation/ source shifting/ mesh/ nodal analysis and reduce given network using star-delta transformation/ source transformation/ source shifting.
CO2	Solve network problems by applying Superposition/ Reciprocity/ Thevenin‘s/ Norton‘s/ Maximum Power Transfer/ Millman‘s Network Theorems and electrical laws to reduce circuit complexities and to arrive at feasible solutions.
CO3	Calculate current and voltages for the given circuit under transient conditions and apply Laplace transform to solve the given network.
CO4	Solve the given network using specified two port network parameter like Z or Y or T or h.
CO5	Understand the concept of resonance and determine the parameters that characterize series/parallel resonant circuits.
Course Code	**18EC33 - ELECTRONIC DEVICES**
CO1	Understand the principles of semiconductor Physics
CO2	Understand the principles and characteristics of different types of semiconductor devices
CO3	Understand the fabrication process of semiconductor devices
CO4	Utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems
CO5	Identify the mathematical models of MOS transistors for circuits and systems.
Course Code	**18EC34 - DIGITAL SYSTEM DESIGN**
CO1	Explain the concept of combinational and sequential logic circuits
CO2	Analyze and design the combinational logic circuits.
CO3	Describe and characterize flip-flops and its applications.
CO4	Design the sequential circuits using SR, JK, D, T flip-flops and Mealy & Moore machines
CO5	Design applications of combinational & Sequential circuits
Course Code	**18EC35 - COMPUTER ORGANIZATION AND ARCHITECTURE**
CO1	Explain the basic organization of a computer system
CO2	Describe the addressing modes, instruction formats and program control statement.
CO3	Explain different ways of accessing an input / output device including interrupts

CO4	Illustrate the organization of different types of semiconductor and other secondary storage memories
CO5	Illustrate simple processor organization based on hardwired control and micro programmed control
Course Code	**18EC36 - POWER ELECTRONICS AND INSTRUMENTATION**
CO1	Build and test circuits using power electronic devices
CO2	Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters and SMPS
CO3	Analyze instrument characteristics and errors.
CO4	Describe the principle of operation and develop circuits for multirange ammeters, voltmeters and bridges to measure passive component values and frequency.
CO5	Explain the principle, design and analyze the transducers for measuring physical parameters,
Course Code	**18ECL37 - ELECTRONIC DEVICES AND INSTRUMENTATION LABORATORY**
CO1	Recognize and demonstrate functioning of semiconductor power devices.
CO2	Evaluate the characteristics, switching, power conversion and control by semiconductor power devices.
CO3	Analyze the response and plot the chracteristics of transducers such as LDR, Photo Diode, etc.
CO4	Design and test simple electronic circuits for measurement of temperature and resistance.
CO5	Use of circuit simulation software are for the implementation and characterization of electronic circuits and devices
Course Code	**18ECL38 - DIGITAL SYSTEM DESIGN LABORATORY**
CO1	Design, realize and verify De Morgan's Theorem, SOP, POS forms.
CO2	Demonstrate the truth table of various expressions and combinational circuits using logic gates.
CO3	Design various combinational circuits such as adders, subtractors, comparators, multiplexers and de-multiplexers
CO4	Construct flips-flops, counters and shift registers.
CO5	Simulate serial adder and binary multiplier
Course Code	**18EC42 - ANALOG CIRCUITS**
CO1	Understand the characteristics of BJTs and FETs
CO2	Design and analyze BJT and FET amplifier circuits
CO3	Design sinusoidal and non sinusoidal oscillators
CO4	Understand the functioning of linear Ics
CO5	Design of linear IC based circuits
Course Code	**18EC43- CONTROL SYSTEMS**
CO1	Develop the mathematical model of mechanical and electrical systems
CO2	Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method
CO3	Determine time domain specifications for first and second order systems
CO4	Determine the stability of a system in the time domain using Route Harvitz criteria and root locus technique
CO5	Determine the stability of a system in the frequency domain using Nyquist and bode plots

Course Code	18EC44 - ENGINEERING STATISTICS and LINEAR ALGEBRA
CO1	Analyze the evaluate single and multiple random variables.
CO2	Identify and associate random variables and random processes in communication events
CO3	Analyze and model the random events in typical communication events to extract quantitative statistical parameters
CO4	Analyze and model typical signal sets in terms of a basis function set of amplitude, phase and frequency
CO5	Demonstrate by way of simulation or emulation the ease of analysis employing basis functions, statistical representation and eigen values
Course Code	**18EC45 - SIGNALS AND SYSTEMS**
CO1	Analyze the different types of signals and systems
CO2	Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.
CO3	Evaluate the convolution sum and integral.
CO4	Represent continuous and discrete signals & systems in frequency domain using fourier representation.
CO5	Analyze discrete time signals and systems using Z-transforms.
Course Code	**18EC46- MICROCONTROLLER**
CO1	Explain the difference between Microprocessor & Microcontrollers, architectures of 8051 microcontroller, interfacing of 8051 to external memory and instruction set of 8051
CO2	Write 8051 assembly level programs using 8051instruction set
CO3	Explain the interrupt system, operation of timers/counters and serial port of 8051
CO4	Write 8051 assembly languate programs to generate square wave on 8051 i/o port pin using interrupt and c programme to send and receive serial data using 8051 serial port
CO5	Interface simple switches, simple LEDs, ADC 0804, LCD and stepper motor to 8051 using 8051 i/o ports
Course Code	**18ECL47 - MICROCONTROLLER LABORATORY**
CO1	Enhance programming skills using Assembly language and C.
CO2	Write assembly language programs in 8051 for solving simple problems that manipulate input data using different instructions of 8051
CO3	Interface different input and output devices to 8051 and control them using assembly language programs
CO4	Interface the serial devices to 8051 and to the serial transfer using C Programming
CO5	Develop applications based on Microcontroller 8051.
Course Code	**18ECL48 - ANALOG CIRCUITS LABORATORY**
CO1	Analyze frequency response of JFET/MOSFET amplifier.
CO2	Design BJT/FETs amplifier with and without feedback and evaluate their performance characteristics
CO3	Apply the knowledge gained in the design of BJT/FET circuits in oscillators.
CO4	Design analog circuits using OPAMPs for different applications
CO5	Simulate and analyze analog circuits that uses IC s for different electronic applications

Course Code	18ES51 - TECHNOLOGICAL INNOVATION MANAGEMENT AND ENTREPRENEURSHIP
CO1	Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business
CO2	Identify the various organizations architecture
CO3	Describe the functions of Managers, Entrepreneurs and their social responsibilities
CO4	Understand the components in developing a business plan
CO5	Recognize the various sources of funding and institutions supporting entrepreneurs
Course Code	**18EC52 - DIGITAL SIGNAL PROCESSING**
CO1	Determine response of LTI systems using time domain and DFT techniques.
CO2	Compute DFT of real and complex discrete time signals.
CO3	Computation DFT using FFT algorithms and linear filtering approach.
CO4	Design and realize FIR and IIR digital filters
CO5	Understand the DSP processor architecture
Course Code	**18EC53 - PRINCIPLES OF COMMUNICATION SYSTEMS**
CO1	Analyze and compute performance of AM and FM modulation in the presence of noise at the receiver
CO2	Analyze and compute performance of digital formatting processes with quantization noise.
CO3	Multiplex digitally formatted signals at transmitter
CO4	De-multiplex the signals and reconstruct digitally formatted signals at the receiver
CO5	Design / Demonstrate the use of digital formatting in Multiplexers, vocoders and video transmission
Course Code	**18EC54 - INFORMATION THEORY AND CODING**
CO1	Explain concept of Dependent & Independent Source, measure of information, Entropy, Rate of Information and Order of a source
CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
CO3	Model the continuous and discrete communication channels using input, output and joint probabilities
CO4	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes
CO5	Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.
Course Code	**18EC55 - ELECTROMAGNETIC WAVES**
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, volume
	charges by applying conventional methods and charge in a volume
CO2	Apply Guass law to evaluate electric fields due to different charge distributions and volume charge distribution by using divergence theorem
CO3	Determine potential and energy with respect to point charge and capacitance using Laplace equation and apply biot savarts and amperes laws for evaluating magnetic field for different current configurations
CO4	Calculate magnetic force, potential energy and magnetization with respect to magnetic materials and voltage induced in electric circuits
CO5	Apply maxwells equation for time varying fields, EM waves in free space and conductors and evaluate power associated with EM waves using poynting theorem

Course Code	18EC56- VERILOG HDL
CO1	Write Verilog programs in gate, dataflow (RTL), behavioral and switch modeling levels of Abstraction.
CO2	Design and verify the functionality of digital circuit/system using test benches.
CO3	Identify the suitable Abstraction level for a particular digital design.
CO4	Write the programs more effectively using Verilog tasks and directives.
CO5	Perform timing and delay Simulation and interpret the various constructs in logic synthesis
Course Code	**18ECL57 - DIGITAL SIGNAL PROCESSING LABORATORY**
CO1	Understand the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
CO2	Modelling of discrete time signals and systems and verification of its properties and results.
CO3	Implementation of discrete computations using DSP processor and verify the results.
CO4	Realize the digital filters using a simulation tool and analyze the response of the filter for an audio signal.
CO5	Write programs using Matlab / Scilab/Octaye to illustrate DSP concepts.
Course Code	**18ECL58 - HDL LABORATORY**
CO1	Write the Verilog/VHDL programs to simulate Combinational circuits in Dataflow, Behavioral and Gate level Abstractions.
CO2	Describe sequential circuits like flip flops and counters in Behavioral description and obtain simulation waveforms. description and obtain simulation waveforms.
CO3	Use FPGA/CPLD kits for down loading verilog codes and check output.
CO4	Synthesize Combinational and Sequential circuits on programmable ICs and test the hardware.
CO5	Interface the hardware to the programmable chips and obtain the required output.
Course Code	**18CIV59 - ENVIRONMENTAL STUDIES**
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a globe scale.
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
CO5	Relate to the lates developments in environmental pollution mitigation tools.
Course Code	**18EC61 - DIGITAL COMMUNICATION**
CO1	Associate and apply the concepts of Band pass sampling to well specified signals and channels.
CO2	Analyze and compute performance parameters and transfer rates for low pas and Band pass symbol under ideal and corrupted non band limited channels.
CO3	Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted band limited channels.

CO4	Demonstrate that band pass signals subjected to corruption and distortion in a Band limited channel can be processed at the receiver to meet specified performance criteria
CO5	Understand the principles of spread spectrum communications.
Course Code	**18EC62 -EMBEDDED SYSTEMS**
CO1	Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3
CO2	Apply the knowledge gained for Programming ARM Cortex M3 for different applications
CO3	Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system
CO4	Develop the hardware /software co-design and firmware design approaches
CO5	Explain the need of real time operating system for embedded system applications
Course Code	**18EC63 – MICROWAVE AND ANTENNAS**
CO1	Describe the use and advantages of microwave transmission
CO2	Analyze various parameters related to microwave transmission lines and waveguides
CO3	Identify microwave devices for several applications
CO4	Analyze various antenna parameters necessary for building an RF system
CO5	Recommend various antenna configurations according to the applications
Course Code	**18EC641 – OPERATING SYSTEM**
CO1	Explain the goals, structure, operation and types of operating systems.
CO2	Apply scheduling techniques to find performance factors.
CO3	Explain organization of file systems and IOCS.
CO4	Apply suitable techniques for contiguous and non-contiguous memory allocation.
CO5	Describe message passing, deadlock detection and prevention methods.
Course Code	**18ECL66 - EMBEDDED SYSTEMS LABORATORY**
CO1	Understand the instruction set of 32 bit microcontroller ARM Cortex M3, and the software tool required for programming in Assembly and C language
CO2	Develop assembly language programs using ARM Cortex M3 for different applications
CO3	Interface external devices and I/O with ARM Cortex M3
CO4	Develop C language programs and library functions for embedded system applications
CO5	Analyze the functions of varous peripherals, peripheral registers and power saving modes of ARM Cortex M3
Course Code	**18ECL67 – COMMUNICATION LABORATORY**
CO1	Design and test circuits for analog modulation and demodulation schemes viz., AM, FM, etc.
CO2	Determine the characteristics and response of microwave waveguide.
CO3	Determine the characteristics of microstrip antennas and devices and compute the parameters associated with it.
CO4	Design and test the digital and analog modulation circuits and display the waveforms.
CO5	Simulate the digital modulation systems and compare the error performance of basic digital modulation schemes
Course Code	**18EC71 – COMPUTER NETWORKS**
CO1	Understand the concepts of networking.

CO2	Describe the various networking architectures.
CO3	Identify the protocols and services of different layers.
CO4	Distinguish the basic network configurations and standards associated with each network
C05	Analyze a simple network and measure its parameters
Course Code	**18EC72 – VLSI DESIGN**
CO1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
CO2	Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
CO3	Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements
CO4	Interpret Memory elements along with timing considerations
CO5	Interpret testing and testability issues in VLSI Design
Course Code	**18EC733 – DIGITAL IMAGE PROCESSING**
CO1	Describe the fundamentals of digital image processing.
CO2	Understand image formation and the role human visual system plays in perception of gray and color image data.
CO3	Apply image processing techniques in both the spatial and frequency (Fourier) domains.
CO4	Design and evaluate image analysis techniques
CO5	Conduct independent study and analysis of Image Enhancement and restoration techniques
Course Code	**18EC743 – MULTIMEDIA COMMUNICATION**
CO1	Understand basics of different multimedia networks and applications. Analyse different media types to represent them in digital form.
CO2	Understand different compression techniques to compress audio and video.
CO3	Describe multimedia Communication across Networks.
CO4	Analyze different media types to represent them in digital form.
CO5	Compress different types of text and images using different compression techniques
Course Code	**18ECL76 – COMPUTER NETWORKS LABORATORY**
CO1	Choose suitable tools to model a network.
CO2	Use the network simulator for learning and practice of networking algorithms.
CO3	Illustrate the operations of network protocols and algorithms using C programming.
CO4	Simulate the network with different configurations to measure the performance parameters.
CO5	Implement the data link and routing protocols using C programming.
Course Code	**18ECL77 - VLSI LABORATORY**
CO1	Design and simulate combinational and sequential digital circuits using Verilog HDL.
CO2	Understand the Synthesis process of digital circuits using EDA tool.
CO3	Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level net list
CO4	Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.
CO5	Perform RTL-GDSII flow and understand the stages in ASIC design

Course Code	18EC81 – WIRELESS AND CELLULAR COMMUNICATION
CO1	Understand the communication theory both physical and networking associated with GSM, CDMA & LTE 4G systems.
CO2	Explain concepts of propagation mechanisms like Reflection, Diffraction, Scattering in wireless channels.
CO3	Develop a scheme for idle mode, call set up, call progress handling and call tear down in a GSM cellular network.
CO4	Develop a scheme for idle mode, call set up, call progress handling and call tear down in a CDMA cellular network.
CO5	Understand the Basic operations of Air interface in a LTE 4G system.
Course Code	**18EC821 – NETWORK SECURITY**
CO1	Explain network security services and mechanisms and explain security concepts
CO2	Understand the concept of Transport Level Security and Secure Socket Layer.
CO3	Explain Security concerns in Internet Protocol security
CO4	Explain Intruders, Intrusion detection and Malicious Software
CO5	Describe Firewalls, Firewall Characteristics, Biasing and Configuration

PROGRAMME OUTCOME, PROGRAMMESPECIFIC OUTCOMES AND COURSEOUTCOMES OF ALL DEPARTMENTS–2020-21(CRITERIA- 2)

2.6.1 Program outcomes, program specific outcomes and course outcomes

Department of Electrical & Electronics Engineering

Program Outcomes (PO's)

PO 1: Engineering Knowledge: Apply knowledge of differential equations, vector calculus, complex variables, matrix theory, probability theory, physics and chemistry, electrical and electronic engineering fundamentals.

PO 2: Problem Analysis: Graduates will Identify, formulate and solve complex electrical and electronics engineering problems using the first principles of mathematics natural sciences and engineering science

PO 3: Design: Graduates will design Electrical and Electronics systems meeting the given specifications for different problems taking safety and precautions into consideration.

PO 4: Investigations: Graduates will Perform investigations, design and conduct experiments, analyze and interpret the results to provide valid conclusions.

PO 5: Tool Usage: Graduates will use modern software tools to model and analyze problems, apply appropriate techniques and IT tools for the design & analysis of the systems keeping in view their limitations.

PO 6: The Engineer and Society: Graduates will understand the impact of local and global issues / happenings and assess societal, health, legal and cultural issues with competency in professional engineering practice on Electrical Engineers.

PO 7: Environment and Sustainability: Graduates will Demonstrate professional skills and contextual reasoning and provide sustainable solutions for problems related to Electrical and Electronics Engineering and also will understand their impact on environment.

PO 8: Ethics: Graduates will have knowledge of professional ethics and code of conduct as applied to Electrical Engineers.

PO 9: Individual and Team work: Graduates will work effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.

PO 10: Communication: Graduates will communicate effectively in both verbal and written form among engineering community, being able to comprehend and write reports, presentation and give / receive clear instructions.

PO 11: Project Management and Finance: Graduates will plan, demonstrate and execute engineering & management principles in their own / team projects in multidisciplinary environment

PO 12: Life-long learning: Graduates will have the ability for self- education ,recognize the need for and have the ability to engage in independent and lifelong learning.

Program Specific Outcomes (PSO's)

PSO 1: Ability to specify architect, design and analyze systems that efficiency generate, transmit, distribute and utilize electrical power.

PSO 2: Ability to specify design, prototype and test modern electronic systems that perform analog and digital processing function.

PSO 3: Ability to use software for design, simulation and analysis of electrical system.

ELECTRICAL & ELECTRONICS ENGINEERING
21SCHEME

COURSE CODE	**21ELE13 BASIC ELECTRICAL ENGINEERING**
CO1	Analyse basic DC and AC electric circuits.
CO2	Explain the working principles of transformers and electrical machines
CO3	Explain the concepts of electric power transmission and distribution of power
CO4	Understand the wiring methods, electricity billing, and working principles of circuit protectivedevices and personal safety measures.
COURSE CODE	**21ELE23 BASIC ELECTRICAL ENGINEERING**
CO1	Analyse basic DC and AC electric circuits.
CO2	Explain the working principles of transformers and electrical machines
CO3	Explain the concepts of electric power transmission and distribution of power
CO4	Understand the wiring methods, electricity billing, and working principles of circuit protectivedevices and personal safety measures.
COURSE CODE	**21MAT31 Transform Calculus, Fourier Series and Numerical Techniques (Common to all Branches)**
CO1	To solve ordinary differential equations using Laplace transform.
CO2	Demonstrate the Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
CO3	To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations
CO4	To solve mathematical models represented by initial or boundary value problems involving partial differential equations
CO5	Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
COURSE CODE	**21EE32 Analog Electronic Circuits and Op - Amps**
CO1	Obtain the output characteristics of clipper and clamper circuits
CO2	Design and compare biasing circuits for transistor amplifiers & explain the transistor switching.
CO3	Explain the concept of feedback, its types and design of feedback circuits

CO4	Design and analyse the power amplifier circuits and oscillators for different frequencies.
CO5	Design and analysis of FET and MOSFET amplifiers.
CO6	Demonstrate the application of Op-amps.
COURSE CODE	**21EE33 Electric circuit Analysis**
CO1	Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using source shifting, source transformation and network reduction using transformations.
CO2	Solve complex electric circuits using network theorems.
CO3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
CO4	Synthesize typical waveforms using Laplace transformation.
CO5	Solve unbalanced three phase systems and also evaluate the performance of two port networks.
COURSE CODE	**21EE34 Transformer and generators**
CO1	Understand the construction and operation of 1-phase, 3-Phase transformers, and Autotransformer.
CO2	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.
CO3	Understand the construction and working of AC and DC Generators
CO4	Analyze the performance of the AC Generators on infinite bus and parallel operation
CO5	Determine the regulation of AC Generator by Slip test, EMF, MMF, and ZPF Methods.
COURSE CODE	**21EEL35 Electrical Machines Laboratory - 1**
CO1	Evaluate the performance of transformers from the test data obtained.
CO2	Connect and operate two single phase transformers of different KVA rating in parallel.
CO3	Connect single phase transformers for three phase operation and phase conversion.
CO4	Compute the voltage regulation of synchronous generator using the test data obtained in the laboratory
CO5	Evaluate the performance of synchronous generators from the test data and assess the performance of synchronous generator connected to infinite bus.

COURSE CODE	**21EEL381 Scilab for Transformers and Generators**
CO1	Analyse in an intelligent manner, think better, and perform better.

COURSE CODE	21EEL382 Circuit Laboratory using Pspice
CO1	Analyse in an intelligent manner, think better, and perform better.
COURSE CODE	**21EEL383 555 IC Laboratory**
CO1	Analyse in an intelligent manner, think better, and perform better.
COURSE CODE	**21EEL384 Scilab for Mathematics**
CO1	Analyse in an intelligent manner, think better, and perform better.
COURSE CODE	**21MAT41 Complex Analysis, Probability and Statistical Methods**
CO1	Use the concepts of an analytic function and complex potentials to solve the problems arising in electromagnetic field theory. Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
CO2	Obtain Series Solutions of Ordinary Differential Equation.
CO3	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO4	Apply discrete and continuous probability distributions in analysing the probability models arising in the engineering field.
CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
COURSE CODE	**21EE42 Digital System Design**
CO1	Develop simplified switching equation using Karnaugh Maps and QuineMcClusky techniques.
CO2	Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational control circuits
CO3	Design flip flops, counters, shift registers as sequential control circuits.
CO4	Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.
CO5	Explain the functioning of Read only and Read/Write Memories, Programmable ROM, EPROM and Flash memory.
CO6	Realize Boolean expressions, adders and subtractors using gates.
CO7	Design and test Ring counter/Johnson counter, Sequence generator and 3 bit counters.

COURSE CODE	21EE43 Microcontroller
CO1	Outline the 8051 architecture, registers, internal memory organization, addressing modes.
CO2	Discuss 8051 addressing modes, instruction set of 8051, accessing data and I/O port programming.
CO3	Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion and timer/counter programming.
CO4	Summarize the basics of serial communication and interrupts, also develop 8051 programs for serial data communication and interrupt programming.
CO5	Program 8051to work with external devices for ADC, DAC, Stepper motor control, DC motor control.
COURSE CODE	**21EE44 Electric Motors**
CO1	Explain the construction, operation and classification of DC Motor, AC motor and special purpose motors.
CO2	Describe the performance characteristics and applications of Electric motors.
CO3	Demonstrate and explain the methods of testing of DC machines and determine losses and efficiency.
CO4	Control the speed of DC motor and induction motor.
CO5	Explain the starting methods, equivalent circuit and phasor diagrams, torque angle, effect of change in excitation and change in load, hunting and damping of synchronous motors.
COURSE CODE	**21EEL46 Electrical Machines Laboratory - 2**
CO1	Test DC machines to determine their characteristics and also to control the speed of DC motor.
CO2	Pre-determine the performance characteristics of DC machines by conducting suitable tests.
CO3	Perform load test on single phase and three phase induction motor to assess its performance.
CO4	Conduct test on induction motor to pre-determine the performance characteristics.
CO5	Conduct test on synchronous motor to draw the performance curves

COURSE CODE	21EEP481 Microcontroller Based Projects
CO1	Analyse in a systematic way, think better, and perform better.

COURSE CODE	21EEL482 Scilab for Electric Motors
CO1	Analyse in a systematic way, think better, and perform better.

COURSE CODE	21EEL483 Scilab for Electrical and Electronic Measurements
CO1	Analyse in a systematic way, think better, and perform better.

COURSE CODE	21EEL484 Simulation of Op-Amp Circuits
CO1	Analyse in a systematic way, think better, and perform better.

COURSE CODE	21EE51 Transmission and Distribution
CO1	Explain transmission and distribution scheme, identify the importance of different transmission systems and types of insulators.
CO2	Analyze and compute the parameters of the transmission line for different configurations.
CO3	Assess the performance of overhead lines.
CO4	Interpret corona, explain the use of underground cables.
CO5	Classify different types of distribution systems; examine its quality & reliability.

COURSE CODE	21EE52 Control Systems
CO1	Analyze and model electrical and mechanical system using analogous.
CO2	Formulate transfer functions using block diagram and signal flow graphs
CO3	Analyze the stability of control system, ability to determine transient and steady state time response.
CO4	Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.
CO5	Discuss stability analysis using Nyquist plots, Design controller and compensator for a given specification.
CO6	Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.
CO7	Design, analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.
CO8	Determine the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair used in control systems.
CO9	Simulate the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
CO10	Develop a script files to plot Root locus, Bode plot and Nyquist plot to study the stability of a system using software package.

COURSE CODE	21EE53 Power System Analysis - 1
CO1	Model the power system components & construct per unit impedance diagram of power system.
CO2	Analyze three phase symmetrical faults on power system.
CO3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.
CO4	Analyze various unsymmetrical faults on power system.
CO5	Examine dynamics of synchronous machine and determine the power system stability.
Course Code	**21EE54 Power Electronics**
CO1	To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
CO2	To explain the techniques for design and analysis of single phase diode rectifier circuits.
CO3	To explain different power transistors, their steady state and switching characteristics and limitations.
CO4	To explain different types of Thyristors, their gate characteristics and gate control requirements.
CO5	To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.
Course Code	**21EEL55 Power Electronics Laboratory**
CO1	Obtain static characteristics of semiconductor devices to discuss their performance.
CO2	Trigger the SCR by different methods
CO3	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
CO4	Control the speed of a DC motor, universal motor and stepper motors.
CO5	Verify the performance of single phase full bridge inverter connected to resistive load.
Course Code	**21EEL581 Scilab for Analysis of Power Systems**
CO1	Analyse in an intelligent manner, think better, and perform better.
Course Code	**21EEL582 Scilab for Power Electronics**
CO1	Analyse in an intelligent manner, think better, and perform better.
Course Code	**21EEP583 Energy Audit Project**
CO1	To analyze the data collected for energy audit of a building or industry or organization.
CO2	To perform comparative analysis with and without energy audit.
CO3	To analyze the energy saving measures to be considered with economy considerations.

CO4	Analyse in a systematic way, think better, and perform better.
Course Code	**21EEP584 Renewable Energy Projects**
CO1	Analyse in a systematic way, think better, and perform better.
Course Code	**21EE61 Management and Entrepreneurship**
CO1	Explain the field of management, task of the manager, planning and steps in decision making.
CO2	Discuss the structure of organization, importance of staffing, leadership styles, modes of communication, techniques of coordination and importance of managerial control in business.
CO3	Explain the concepts of entrepreneurship and a businessman's social responsibilities towards different groups.
CO4	Show an understanding of role of SSI's in the development of country and state/central level institutions/ agencies supporting business enterprises.
CO5	Discuss the concepts of project management, capital budgeting, project feasibility studies, need for project report and new control techniques.
Course Code	**21EE62 Power System Analysis - 2**
CO1	Formulate network matrices and models for solving load flow problems.
CO2	Perform steady state power flow analysis of power systems using numerical iterative techniques.
CO3	Solve issues of economic load dispatch and unit commitment problems.
CO4	Analyze short circuit faults in power system networks using bus impedance matrix.
CO5	Apply Point by Point method and Runge Kutta Method to solve Swing Equation.
CO6	Develop a program in suitable package to assess the performance of medium and long transmission lines.
CO7	Develop a program in suitable package to obtain the power angle characteristics of salient and non-salient pole alternator.
CO8	Develop a program in suitable package to assess the transient stability under three phase fault at different locations in a of radial power systems.
Course Code	**21EE63 Signals and Digital Signal Processing**
CO1	Discuss classification and basic operations that can be performed on both continuous and discrete time signals.
CO2	Evaluate Discrete Fourier Transform of a sequence and the convolution of two sequences to determine the output sequence.
CO3	Evaluate Discrete Fourier Transform of a sequence by using fast methods.
CO4	Design Butterworth and Chebyshev IIR digital filters and FIR filters using different techniques.
CO5	Develop different structures for IIR and FIR filters.

Course Code	21EE641 Sensors and Transducers
CO1	Classify the transducers and explain the need of transducers, their classification, advantages and disadvantages.
CO2	Explain the working of various transducers and sensors.
CO3	Outline the recent trends in sensor technology and their selection
CO4	Analyze the signal conditioning and signal conditioning equipment.
CO5	Illustrate different configuration of Data Acquisition System and data conversion.
CO6	Show knowledge of data transmission and telemetry.
CO7	Explain measurement of non-electrical quantities -temperature, flow, speed, force, torque, power and viscosity.
Course Code	**21EE642 Electromagnetic Field Theory**
CO1	Use different coordinate systems, Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
CO2	Calculate the energy and potential due to a system of charges & Explain the behavior of electric field across a boundary conditions
CO3	Explain the Poisson's, Laplace equations and behavior of steady magnetic fields.
CO4	Explain the behavior of magnetic fields and magnetic materials.
CO5	Asses time varying fields and propagation of waves in different media.
Course Code	**21EE643 Electrical Machine Design**
CO1	Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
CO2	Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design stator and rotor circuits of a DC machine.
CO3	Derive the output equations of transformer, discuss selection of specific loadings, estimate the number of cooling tubes, no load current and leakage reactance of core type transformer.
CO4	Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, design stator and rotor circuits of a induction motor.
CO5	Formulate the output equation of alternator, design the field windings of Synchronous machine, discuss short circuit ratio and its effects on performance of synchronous machines, design salient pole and non-salient pole alternators for given specifications.

Course Code	21EE644 Electrical Engineering Materials
CO1	Discuss electrical and electronics materials, their importance, classification and operational requirement
CO2	Discuss conducting, dielectric, insulating and magnetic materials used in engineering, their properties and classification.
CO3	Explain the phenomenon superconductivity, super conducting materials and their application in engineering.
CO4	Explain the plastic and its properties and applications.
Course Code	**21EE651 Utilization of Electrical Power**
CO1	Discuss different methods of electric heating & welding.
CO2	Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.
CO3	Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems.
CO4	Analyze systems of electric traction, speed time curves and mechanics of train movement.
CO5	Explain the motors used for electric traction, their control & braking and power supply system used for electric traction.
Course Code	**21EE652 Renewable Energy Resources**
CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO5	Discuss production of energy from biomass, biogas.
CO6	Summarize tidal energy resources, sea wave energy and ocean thermal energy.
Course Code	**21EE653 Industrial Servo Control Systems**
CO1	Explain the evolution and classification of servos, with descriptions of servo drive actuators, amplifiers, feedback transducers, performance, and troubleshooting techniques.
CO2	Discuss system analogs, vectors and transfer functions of differential equations.
CO3	Discuss mathematical equations for electric servo motors, both DC and brushless DC servo motors.
CO4	Discuss mathematical equations for electric servo motors, both DC and brushless DC servo motors.
Course Code	**21EE654 Advanced Control Systems**
CO1	Discuss state variable approach for linear time invariant systems in both the continuous and discrete time systems.
CO2	Develop of state models for linear continuous–time and discrete–time systems.
CO3	Apply vector and matrix algebra to find the solution of state equations for linear continuous–time and discrete–time systems.

CO4	Define controllability and observability of a system and test for controllability and observability of a given system.
CO5	Design pole assignment and state observer using state feedback.
CO6	Develop the describing function for the nonlinearity present to assess the stability of the system.
CO7	Develop Lyapunov function for the stability analysis of nonlinear systems
Course Code	**21EEL66 Digital Signal Processing Laboratory**
CO1	Conduct sampling of signals in time and frequency domains.
CO2	Evaluate the impulse response of a system.
CO3	Obtain convolution of given sequences to evaluate the response of a system.
CO4	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.
CO5	Provide a solution for a given difference equation.
CO6	Design and implement IIR and FIR filters.
Course Code	**21EE71 High Voltage and Power System Protection**
CO1	Apply the knowledge of dielectric property for insulation, it's performances as per Standards and High voltage application in power system Equipment's.
CO2	Analyze the circuits of high voltages, high currents in Generation and Measurements.
CO3	Apply relays to the power system protection.
CO4	Discuss the construction, operating principles and performances of circuit breaker.
CO5	Discuss protection of generators, motors, Transformer and Bus Zone Protection.
CO6	Describe the causes of over voltages and their remedial measures.
CO7	Analyze the spark over characteristics using High voltages for checking the breakdown phenomenon and dielectric strength of dielectric materials
CO8	Experimentally verify the characteristics of over current, over voltage, under voltage using electromagnetic, static, distance and impedance relays.
CO9	Demonstration of protective schemes for motor and feeders.

Course Code	**21EE72 Power System Operation and Control**
CO1	Describe various levels of controls in power systems, architecture and configuration of SCADA.
CO2	Develop and analyze mathematical models of Automatic Load Frequency Control.
CO3	Develop mathematical model of Automatic Generation Control in Interconnected Power system.
CO4	Discuss the Control of Voltage, Reactive Power and Voltage collapse.

CO5	Explain security, contingency analysis, and state estimation of power systems.
Course Code	**21EE721 Power System Planning**
CO1	Discuss primary components of power system planning, planning methodology for optimum power system expansion and load forecasting.
CO2	Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions
CO3	Discuss expansion of power generation and planning for system energy in the country, evaluation of operating states of transmission system, their associated contingencies and the stability of the system.
CO4	Discuss principles of distribution planning, supply rules, network development and the system studies
CO5	Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies
CO6	Discuss planning and implementation of electric –utility activities, market principles and the norms framed.
Course Code	**21EE722 Smart Grid**
CO1	Discuss the progress made by different stakeholders in the design and development of smart grid.
CO2	Explain measurement techniques using Phasor Measurement Units and smart meters
CO3	Discuss tools for the analysis of smart grid and design, operation and performance
CO4	Discuss classical optimization techniques and computational methods for smart grid design, planning and operation.
CO5	Explain predictive grid management and control technology for enhancing the smart grid performance
CO6	Develop cleaner, more environmentally responsible technologies for the electric system.
CO7	Discuss the computational techniques, communication, measurement, and monitoring technology tools essential to the design of the smart grid.
CO8	Explain methods to promote smart grid awareness and making the existing transmission system smarter by investing in new technology.
Course Code	**21EE723 ANN with Applications to Power Systems**
CO1	Develop Neural Network and apply elementary information processing tasks that neural network can solve.
CO2	Develop Neural Network and apply powerful, useful learning techniques.
CO3	Develop and Analyze multilayer feed forward network for mapping provided through the first network layer and error back propagation algorithm.
CO4	Analyze and apply algorithmic type problems to tackle problems for which algorithms are not available.
CO5	Develop and Analyze supervised/unsupervised, learning modes of Neural Network for different applications.
Course Code	**21EE724 Electrical Vehicle Technologies**
CO1	Explain the working of electric vehicles and recent trends.

CO2	Analyze different power converter topology used for electric vehicle application.
CO3	Develop the electric propulsion unit and its control for application of electric vehicles.
CO4	Design converters for battery charging and explain transformer less topology.
Course Code	**21EE725 PLC and SCADA**
CO1	Discuss history of PLC and describe the hardware components of PLC: I/O modules, CPU, memory devices, other support devices, operating modes and PLC programming.
CO2	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
CO3	Analyze PLC timer and counter ladder logic programs and describe the operation of different program control instructions
CO4	Discuss the execution of data transfer instructions, data compare instructions and the basic operation of PLC closed-loop control system.
CO5	Describe the operation of mechanical sequencers, bit and word shift registers, processes and structure of control systems and communication between the processes.
Course Code	**21EE731 Computer Aided Electrical Drawing**
CO1	Develop armature winding diagram for DC and AC machines.
CO2	Develop a Single Line Diagram of Generating Stations and substation using the standard symbols.
CO3	Construct sectional views of core type and shell type transformers using the design data.
CO4	Construct sectional views of assembled DC and AC machine and their parts using the design data or the sketches.
Course Code	**21EE732 Micro- and Nano-Scale Sensors and Transducers**
CO1	Understand the differences between the sensor and transducer technology based on nanotechnology and nanofabrication and the classical sensor technologies
CO2	Make an informed selection of a sensor or transducer for a particular application
CO3	Become knowledgeable about the technologies that are available commercially at the present time.
Course Code	**21EE733 Big Data Analytics in Power Systems**
CO1	Discuss role of big data and machine-learning methods applicable to power systems and in particular to Smart Grid communications.
CO2	Discuss optimization methods which are suitable for big data models in power systems.
CO3	Discuss various cyber security issues, electricity theft detection and mitigation that exist in IoT-enabled future power systems.

CO4	Discuss renewable energy planning concerns associated with planned future power systems that have high renewable penetration.
Course Code	**21EE734 Industrial Drives and Applications**
CO1	Explain the advantages, choice and control of electric drive
CO2	Explain the dynamics, generating and motoring modes of operation of electric drives
CO3	Explain the selection of motor power rating to suit industry requirements
CO4	Analyze the performance & control of DC motor drives using controlled rectifiers
CO5	Analyze the performance & control of converter fed Induction motor, synchronous motor & stepper motor drives.
Course Code	**21EE735 FACTS and HVDC**
CO1	Discuss transmission interconnections, flow of Power in an AC System, limits of the loading capability, dynamic stability considerations of a transmission interconnection and controllable parameters.
CO2	Explain the basic concepts, definitions of flexible ac transmission systems and benefits from FACTS technology.
CO3	Describe shunt controllers, Static Var Compensator and Static Compensator for injecting reactive power in the transmission system in enhancing the controllability and power transfer capability.
CO4	Describe series Controllers Thyristor-Controlled Series Capacitor (TCSC) and the Static Synchronous Series Compensator (SSSC) for control of the transmission line current.
CO5	Explain advantages of HVDC power transmission, overview and organization of HVDC system.
CO6	Describe the basic components of a converter, the methods for compensating the reactive power demanded by the converter.
CO7	Explain converter control for HVDC systems, commutation failure, control functions.
Course Code	**21EE741 Carbon Capture and Storage**
CO1	Discuss the impacts of climate change and the measures that can be taken to reduce emissions.
CO2	Discuss carbon capture and carbon storage.
CO3	Explain the fundamentals of power generation.
CO4	Explain methods of carbon capture from power generation and industrial processes.
CO5	Explain different carbon storage methods: storage in coal seams, depleted gas reservoirs and saline formations.
CO6	Explain Carbon dioxide compression and pipeline transport.
Course Code	**21EE742 Electric Vehicles**
CO1	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
CO2	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
CO3	Model batteries, Fuel cells, PEMFC and super capacitors

CO4	Analyze DC and AC drive topologies used for electric vehicle application.
CO5	Develop the electric propulsion unit and its control for application of electric vehicles.
Course Code	**21EE743 Disasters Management**
CO1	Discuss disaster management plan, cyclones and their hazard potential
CO2	Understand the role of IMD and cyclone prediction and cyclone warning system in India
CO3	Understand the role of different institutions defence and other services in natural disaster management.
CO4	Understand the role of Central Water Commission in river water sharing, Draught, its assessment and draught management plan
CO5	Understand occurrence of earth quake, Tsunamis and thunderstorms.
Course Code	**21EE744 Electrical Power Quality**
CO1	Define Power quality; evaluate power quality procedures and standards.
CO2	Estimate voltage sag performance; explain principles of protection and Sources of transient over voltages.
CO3	Identify various sources of harmonics, explain effects of harmonic distortion.
CO4	Evaluate harmonic distortion, control harmonic distortion.
CO5	Estimate power quality in distribution planning. Identify power quality issues in utility system.
Course Code	**21EE745 Energy Conservation and Audit**
CO1	Analyze about energy scenario nationwide and worldwide , also outline Energy Conservation Act and its features.
CO2	Discuss load management techniques and energy efficiency.
CO3	Understand the need of energy audit and energy audit methodology.
CO4	Understand various pillars of electricity market design.
CO5	Conduct energy audit of electrical systems and buildings.
CO6	Show an understanding of demand side management and energy conservation.

ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

COURSE CODE	18ELE14/24 BASIC ELECTRICAL ENGINEERING
CO1	To predict the behaviour of electrical and magnetic circuits.
CO2	Select the type of generator / motor required for a particular application.
CO3	Realize the requirement of transformers in transmission and distribution of electric power and other applications.
CO4	Practice Electrical Safety Rules & standards.
CO5	To function on multi-disciplinary teams.
COURSE CODE	**18ELEL17/27 BASIC ELECTRICAL ENGINEERING LABOROTORY**
CO1	Identify the common electrical components and measuring instruments used for conducting experiments in the electrical laboratory.
CO2	Compare power factor of lamps.
CO3	Determine impedance of an electrical circuit and power consumed in a 3 phase load.
CO4	Determine the Earth Resistance and understand two way and three way control of lamps.
COURSE CODE	**18MAT31 TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES**
CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering
CO2	Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory
CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arisingin wave and heat propagation, signals and systems
CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
CO5	Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.
COURSE CODE	**18EE32 ELECTRIC CIRCUIT ANALYSIS (Core Subject)**
CO1	Understand the basic concepts, basic laws and methods of analysis of DC and AC networks and reduce the complexity of network using source shifting, source transformation and network reduction using transformations

CO2	Solve complex electric circuits using network theorems
CO3	Discuss resonance in series and parallel circuits and also the importance of initial conditions and their evaluation.
CO4	Synthesize typical waveforms using Laplace transformation.
CO5	Solve unbalanced three phase systems and also evaluate the performance of two port networks
COURSE CODE	**18EE33 TRANSFORMERS AND GENERATORS**
CO1	Understand the construction and operation of 1-phase, 3-Phase transformers and Autotransformer.
CO2	Analyze the performance of transformers by polarity test, Sumpner's Test, phase conversion, 3-phase connection, and parallel operation.
CO3	Understand the construction and working of AC and DC Generators. ·.
CO4	Analyze the performance of the AC Generators on infinite bus and parallel operation
CO5	Determine the regulation of AC Generator by Slip test, EMF, MMF, and ZPF Methods.
COURSE CODE	**18EE34 ANALOG ELECTRONIC CIRCUITS**
CO1	Obtain the output characteristics of clipper and clamper circuits. ·
CO2	Design and compare biasing circuits for transistor amplifiers & explain the transistor switching.
CO3	Explain the concept of feedback, its types and design of feedback circuits ·
CO4	Design and analyze the power amplifier circuits and oscillators for different frequencies
CO5	Design and analysis of FET and MOSFET amplifiers
COURSE CODE	**18EE35 DIGITAL SYSTEM DESIGN**
CO1	Develop simplified switching equation using Karnaugh Maps and QuineMcClusky techniques. ·
CO2	Design Multiplexer, Encoder, Decoder, Adder, Subtractors and Comparator as digital combinational control circuits.
CO3	Design flip flops, counters, shift registers as sequential control circuits. ·
CO4	Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.
CO5	Explain the functioning of Read only and Read/Write Memories, Programmable ROM, EPROM and Flash memory
COURSE CODE	**18EE36 ELECTRICAL AND ELECTRONICMEASUREMENTS (Core Course)**
CO1	Measure resistance, inductance and capacitance using bridges and determine earth resistance. ·
CO2	Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.
CO3	Understand methods of extending the range of instruments & instrument transformers.
CO4	Explain the working of different electronic instruments.
CO5	Explain the working of different display and recording devices

COURSE CODE	18EEL37 ELECTRICALMACHINES LABORATORY - 1
CO1	Evaluate the performance of transformers from the test data obtained. ·
CO2	Connect and operate two single phase transformers of different KVA rating in parallel.
CO3	Connect single phase transformers for three phase operation and phase conversion. ·
CO4	Compute the voltage regulation of synchronous generator using the test data obtained in the laboratory.
CO5	Evaluate the performance of synchronous generators from the test data and assess the performance of synchronous generator connected to infinite bus.
COURSE CODE	18EEL38 ELECTRONICS LABORATORY
CO1	Design and test rectifier circuits with and without capacitor filters. ·
CO2	Determine h-parameter models of transistor for all modes.
CO3	Design and test BJT and FET amplifier and oscillator circuits. ·
CO4	Realize Boolean expressions, adders and subtractors using gates.
CO5	Design and test Ring counter/Johnson counter, Sequence generator and 3 bit counters
COURSE CODE	18MAT41 COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS
CO1	Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory. ·
CO2	Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
CO3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field. ·
CO4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
CO5	Construct joint probability distributions and demonstrate the validity of testing the hypothesis.
COURSE CODE	18EE42 POWER GENERATION AND ECONOMICS
CO1	Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants. ·
CO2	Classify various substations and explain the functions of major equipments in substations.
CO3	Explain the types of grounding and its importance.
CO4	Infer the economic aspects of power system operation and its effects
CO5	Explain the importance of power factor improvement.
COURSE CODE	18EE43 TRANSMISSION AND DISTRIBUTION
CO1	Explain transmission and distribution scheme, identify the importance of different transmission systems and types of insulators.

CO2	Analyze and compute the parameters of the transmission line for different configurations.
CO3	Assess the performance of overhead lines. ·
CO4	Interpret corona, explain the use of underground cables.
CO5	Classify different types of distribution systems; examine its quality & reliability.
COURSE CODE	**18EE44 ELECTRIC MOTORS**
CO1	Explain the construction, operation and classification of DC Motor, AC motor and Special purpose motors.
CO2	Describe the performance characteristics & applications of Electric motors.
CO3	Demonstrate and explain the methods of testing of DC machines and determine losses and efficiency.
CO4	Control the speed of DC motor and induction motor. ·
CO5	Explain the starting methods, equivalent circuit and phasor diagrams, torque angle, effect of change in excitation and change in load, hunting and damping of synchronous motors.
COURSE CODE	**18EE45 ELECTROMAGNETIC FIELD THEORY**
CO1	Use different coordinate systems , Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
CO2	Calculate the energy and potential due to a system of charges & Explain the behavior of electric field across a boundary conditions.
CO3	Explain the Poisson's, Laplace equations and behavior of steady magnetic fields. ·
CO4	Explain the behavior of magnetic fields and magnetic materials.
CO5	Asses time varying fields and propagation of waves in different media.
COURSE CODE	**18EE46 OPERATIONAL AMPLIFIERS AND LINEAR ICs**
CO1	Describe the characteristics of ideal and practical operational amplifier.. ·
CO2	Design filters and signal generators using linear ICs
CO3	Demonstrate the application of Linear ICs as comparators and rectifiers.
CO4	Analyze voltage regulators for given specification using op-amp and IC voltage regulators.
CO5	Summarize the basics of PLL and Timer.
COURSE CODE	**18EEL47 ELECTRICAL MACHINES LABORATORY - 2**
CO1	Test DC machines to determine their characteristics and also to control the speed of DC motor.
CO2	Pre-determine the performance characteristics of DC machines by conducting suitable tests.
CO3	Perform load test on single phase and three phase induction motor to assess its performance.
CO4	Conduct test on induction motor to pre-determine the performance characteristics.

CO5	Conduct test on synchronous motor to draw the performance curves.
COURSE CODE	**18EEL48 OP- AMP AND LINEAR ICS LABORATORY 2**
CO1	To conduct experiment to determine the characteristic parameters of OP-Amp ·
CO2	To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator.
CO3	To design test the OP-Amp as oscillators and filters.
CO4	Design and study of Linear IC's as multivibrator power supplies.
COURSE CODE	**18EE51 MANAGEMENT AND ENTREPRENEURSHIP**
CO1	Explain the field of management, task of the manager, planning and steps in decision making.
CO2	Discuss the structure of organization, importance of staffing, leadership styles, modes of communication,techniques of coordination and importance of managerial control in business.
CO3	Explain the concepts of entrepreneurship and a businessman's social responsibilities towards different groups.
CO4	Show an understanding of role of SSI's in the development of country and state/central level institutions/agencies supporting business enterprises. ·
CO5	Discuss the concepts of project management, capital budgeting, project feasibility studies, need for project report and new control techniques
COURSE CODE	**18EE52 MICROCONTROLLER**
CO1	Outline the 8051 architecture, registers, internal memory organization, addressing modes.
CO2	Discuss 8051 addressing modes, instruction set of 8051, accessing data and I/O port programming. · and timer/counter programming.
CO3	Develop 8051C programs for time delay, I/O operations, I/O bit manipulation, logic and arithmetic operations, data conversion
CO4	Summarize the basics of serial communication and interrupts, also develop 8051 programs for serial data communication and interrupt programming.
CO5	Program 8051 to work with external devices for ADC, DAC, Stepper motor control, DC motor control, Elevator control.
COURSE CODE	**18EE53 POWER ELECTRONICS**
CO1	To give an overview of applications power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
CO2	To explain the techniques for design and analysis of single phase diode rectifier circuits. · ··
CO3	To explain different power transistors, their steady state and switching characteristics and limitations.
CO4	To explain different types of Thyristors, their gate characteristics and gate control requirements.

CO5	To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.
COURSE CODE	**18EE54 SIGNALS AND SYSTEM**
CO1	Explain the generation of signals, behavior of system and the basic operations that can be performed on signals and properties of systems.
CO2	Apply convolution in both continuous and discrete domain for the analysis of systems given impulse response of a system.
CO3	Solve the continuous time and discrete time systems by various methods and their representation by block diagram.
CO4	Perform Fourier analysis for continuous and discrete time, linear time invariant systems.
CO5	Apply Z-transform and properties of Z transform for the analysis of discrete time systems.
COURSE CODE	**18EE55 ELECTRICAL MACHINE DESIGN (Core Course)**
CO1	Identify and list, limitations, modern trends in design, manufacturing of electrical machines and properties of materials used in the electrical machines.
CO2	Derive the output equation of DC machine, discuss selection of specific loadings and magnetic circuits of DC machines, design the field windings of DC machine, and design stator and rotor circuits of a DC machine.
CO3	To explain different power transistors, their steady state and switching characteristics and limitations.
CO4	Develop the output equation of induction motor, discuss selection of specific loadings and magnetic circuits of induction motor, design stator and rotor circuits of a induction motor.
CO5	Formulate the output equation of alternator, design the field windings of Synchronous machine, discuss short circuit ratio and its effects on performance of synchronous machines, design salient pole and non-salient pole alternators for given specifications.
COURSE CODE	**18EE56 HIGH VOLTAGE ENGINEERING**
CO1	Explain conduction and breakdown phenomenon in gases, liquid dielectrics and breakdown phenomenon in solid dielectrics.
CO2	Summarize generation of high voltages and currents
CO3	Outline measurement techniques for high voltages and currents.
CO4	Summarize overvoltage phenomenon and insulation coordination in electric power systems.
CO5	Explain non-destructive testing of materials and electric apparatus, high-voltage testing of electric apparatus
COURSE	**18EEL57 MICROCONTROLLER LABORATORY**

CODE	
CO1	Write assembly language programs for data transfer, arithmetic, Boolean and logical instructions and code conversions.
CO2	Write ALP using subroutines for generation of delays, counters, configuration of SFRs for serial communication and timers.
CO3	Perform interfacing of stepper motor and dc motor for controlling the speed, elevator, LCD, external ADC and temperature control.
CO4	Generate different waveforms using DAC interface.
CO5	Work with a small team to carryout experiments using microcontroller concepts and prepare reports that present lab work.
COURSE CODE	**18EEL58 POWER ELECTRONICS LABORATORY**
CO1	Obtain static characteristics of semiconductor devices to discuss their performance.
CO2	Trigger the SCR by different methods
CO3	Verify the performance of single phase controlled full wave rectifier and AC voltage controller with R and RL loads.
CO4	Control the speed of a DC motor, universal motor and stepper motors.
CO5	Verify the performance of single phase full bridge inverter connected to resistive load.
COURSE CODE	**18EE61 CONTROL SYSTEMS (Core Subject)**
CO1	Analyze and model electrical and mechanical system using analogous.
CO2	Formulate transfer functions using block diagram and signal flow graphs.
CO3	Analyze the stability of control system, ability to determine transient and steady state time response.
CO4	Illustrate the performance of a given system in time and frequency domains, stability analysis using Root locus and Bode plots.
CO5	Discuss stability analysis using Nyquist plots, Design controller and compensator for a given specification.
COURSE CODE	**18EE62 POWER SYSTEM ANALYSIS – 1 (Core Subject)**
CO1	Model the power system components & construct per unit impedance diagram of power system.
CO2	Analyze three phase symmetrical faults on power system.
CO3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.

CO4	Analyze various unsymmetrical faults on power system.
CO5	Examine dynamics of synchronous machine and determine the power system stability
COURSE CODE	**18EE63 DIGITAL SIGNAL PROCESSING (Core Subject)**
CO1	Apply DFT and IDFT to perform linear filtering techniques on given sequences to determine the output.
CO2	Apply fast and efficient algorithms for computing DFT and inverse DFT of a given sequence
CO3	Design and realize infinite impulse response Butterworth and Chebyshev digital filters using impulse invariant and bilinear transformation techniques.
CO4	Develop a digital IIR filter by direct, cascade, parallel, ladder and FIR filter by direct, cascade and linear phase methods of realization.
CO5	Design and realize FIR filters by use of window function and frequency sampling method.
COURSE CODE	**18EE647 SENSORS AND TRANSDUCERS (PROFESSIONAL ELECTIVE)**
CO1	Use gauges and transducers to measure pressure, direction and distance.
CO2	Discuss the use of light transducers and other devices used for the measurement of electromagnetic radiations.
CO3	Explain the working of different temperature sensing devices.
CO4	Discuss the principles and applications of audio electrical sensors and transducers used for the measurement of sound.
CO5	Discuss the use of sensors for the measurement of mass, volume and environmental quantities.
COURSE CODE	**18EE653 RENEWABLE ENERGY RESOURCES (OPEN ELECTIVE)**
CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO4	Discuss production of energy from biomass, biogas.
CO5	Summarize tidal energy resources, sea wave energy and ocean thermal energy.
COURSE CODE	**18EEL66 CONTROL SYSTEM LABORATORY**
CO1	Utilize software package and discrete components in assessing the time and frequency domain response of a given second order system.
CO2	Design, analyze and simulate Lead, Lag and Lag – Lead compensators for given specifications.
CO3	Determine the performance characteristics of ac and DC servomotors and synchro-transmitter receiver pair used in control systems.

CO4	Simulate the DC position and feedback control system to study the effect of P, PI, PD and PID controller and Lead compensator on the step response of the system.
CO5	Develop a script files to plot Root locus, Bode plot and Nyquist plot to study the stability
COURSE CODE	**18EEL67 DIGITAL SIGNAL PROCESSING LABORATORY**
CO1	Explain physical interpretation of sampling theorem in time and frequency domains
CO2	Evaluate the impulse response of a system.
CO3	Perform convolution of given sequences to evaluate the response of a system.
CO4	Compute DFT and IDFT of a given sequence using the basic definition and/or fast methods.
CO5	Provide a solution for a given difference equation.
CO6	Design and implement IIR and FIR filters.
COURSE CODE	**18EEMP68 MINI PROJECT**
CO1	Present the mini-project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills.
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.
COURSE CODE	**18EEMP68 INTERNSHIP**
CO1	Gain practical experience within industry in which the internship is done.
CO2	Acquire knowledge of the industry in which the internship is done.
CO3	Apply knowledge and skills learnt to classroom work.
CO4	Develop a greater understanding about career options while more clearly defining personal career goals.
CO5	Experience the activities and functions of professionals.
CO6	Develop and refine oral and written communication skills.

CO7	Identify areas for future knowledge and skill development.
CO8	Expand intellectual capacity, credibility, judgment, intuition.
CO9	Acquire the knowledge of administration, marketing, finance and economics
COURSE CODE	**18EE71 POWER SYSTEM ANALYSIS – 2(Core Course)**
CO1	Formulate network matrices and models for solving load flow problems.
CO2	Perform steady state power flow analysis of power systems using numerical iterative techniques.
CO3	Solve issues of economic load dispatch and unit commitment problems.
CO4	Analyze short circuit faults in power system networks using bus impedance matrix.
CO5	Apply Point by Point method and Runge Kutta Method to solve Swing Equation.
COURSE CODE	**18EE72 POWER SYSTEM PROTECTION (Core Subject)**
CO1	Discuss performance of protective relays, components of protection scheme and relay terminology over current protection.
CO2	Explain the working of distance relays and the effects of arc resistance, power swings, line length and source impedance on performance of distance relays.
CO3	Discuss pilot protection, construction, operating principles and performance of differential relays and discuss protection of generators, motors, transformer and Bus Zone Protection.
CO4	Explain the construction and operation of different types of circuit breakers.
CO5	Outline features of fuse, causes of overvoltages and its protection, also modern trends in Power System Protection.
COURSE CODE	**18EE731 SOLAR AND WIND ENERGY (Professional Elective)**
CO1	Discuss the importance of the role of renewable energy, the concept of energy storage and the principles of energy storage devices
CO2	Discuss the concept of solar radiation data and solar PV system fabrication, operation of solar cell, sizing and design of PV system.
CO3	Describe the process of harnessing solar energy and its applications in heating and cooling.
CO4	Explain basic Principles of Wind Energy Conversion, collection of wind data, energy estimation and site selection.
CO5	Discuss the performance of Wind-machines, energy storage, applications of Wind Energy and environmental aspects.
COURSE CODE	**18EE742 UTILIZATION OF ELECTRICAL POWER (PROFESSIONAL ELECTIVE)**

CO1	Discuss different methods of electric heating & welding.
CO2	Discuss the laws of electrolysis, extraction, refining of metals and electro deposition process.
CO3	Discuss the laws of illumination, different types of lamps, lighting schemes and design of lighting systems.
CO4	Analyze systems of electric traction, speed time curves and mechanics of train movement.
CO5	Explain the motors used for electric traction, their control & braking and power supply system used for electric traction.
COURSE CODE	**18EE753 DISASTERS MANAGEMENT (OPEN ELECTIVE)**
CO1	Discuss disaster management plan, cyclones and their hazard potential
CO2	Understand the role of IMD and cyclone prediction and cyclone warning system in India
CO3	Understand the role of different institutions defence and other services in natural disaster management.
CO4	Understand the role of Central Water Commission in river water sharing, Draught, its assessment and draught management plan
CO5	Understand occurrence of earth quake, Tsunamis and thunderstorms.
COURSE CODE	**18EEL76 POWER SYSTEM SIMULATION LABORATORY**
CO1	Develop a program in suitable package to assess the performance of medium and long transmission lines.
CO2	Develop a program in suitable package to obtain the power angle characteristics of salient and non-salient pole alternator.
CO3	Develop a program in suitable package to assess the transient stability under three phase fault at different locations in a of radial power systems.
CO4	Develop programs in suitable package to formulate bus admittance and bus impedance matrices of interconnected power systems.
CO5	Use suitable package to solve power flow problem for simple power systems
CO6	Use suitable package to study unsymmetrical faults at different locations in radial power systems
CO7	Use of suitable package to study optimal generation scheduling problems for thermal power plants.
COURSE CODE	**18EEL77 RELAY AND HIGH VOLTAGE LABORATORY**
CO1	Verify the characteristics of over current, over voltage, under voltage and negative sequence relay both electromagnetic and static type
CO2	Verify the characteristics of microprocessor based over current, over voltage, under voltage relays and distance relay.
CO3	Show knowledge of protecting generator, motor and feeders.

CO4	Analyze the spark over characteristics for both uniform and non-uniform configurations using High A and DC voltages.
CO5	Measure high AC and DC voltages and breakdown strength of transformer oil.
CO6	Draw electric field and measure the capacitance of different electrode configuration models.
CO7	Show knowledge of generating standard lightning impulse voltage to determine efficiency, energy of impulse generator and 50% probability flashover voltage for air insulation.
COURSE CODE	**18EEP78 PROJECT PHASE – I**
CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation and solution.
CO3	Design engineering solutions to complex problems utilizing a systems approach.
CO4	Communicate with engineers and the community at large in written an oral forms.
COURSE CODE	**18EE81 POWER SYSTEM OPERATION AND CONTROL(Core Course)**
CO1	Describe various levels of controls in power systems, architecture and configuration of SCADA.
CO2	Develop and analyze mathematical models of Automatic Load Frequency Control
CO3	Develop mathematical model of Automatic Generation Control in Interconnected Power system
CO4	Discuss the Control of Voltage , Reactive Power and Voltage collapse
CO5	Explain security, contingency analysis, state estimation of power systems
COURSE CODE	**18EEP83 PROJECT WORK PHASE -II**
CO1	Present the project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.
COURSE	**18EES84 TECHNICAL SEMINAR**

CODE	
CO1	Attain, use and develop knowledge in the field of engineering and other disciplines through independent learning and collaborative study.
CO2	Identify, understand and discuss current, real-time issues.
CO3	Improve oral and written communication skills.
CO4	Explore an appreciation of the self in relation to its larger diverse social and academic contexts.
CO5	Apply principles of ethics and respect in interaction with others.

PROGRAMME OUTCOME, PROGRAMMESPECIFIC OUTCOMES AND COURSEOUTCOMES OF ALL DEPARTMENTS–2020-21(CRITERIA- 2)

2.6.1 Program outcomes, program specific outcomes and course outcomes

Department of Mechanical Engineering

Program Outcomes (PO's)

PO 1: Engineering Knowledge: Apply the knowledge of Mathematics, Science, Mechanical Engineering, Engineering fundamentals, to the solution of complex engineering problems.

PO 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.

PO 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, societal, and environmental considerations.

PO 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.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, including prediction and modeling to complex Engineering activities with an understanding of the limitations.

PO 6: The Engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional Engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 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.

PO 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 multi-disciplinary environments.

PO 12: Life-long Learning: Recognize the need for identifying contemporary technical challenges and redefining to develop solutions to satisfy given criteria in an optimal manner using creativity in design.

Program Specific Outcomes (PSO's)

PSO 1: Apply their knowledge in the domain of engineering mechanics, thermal and fluid sciences to solve engineering problems utilizing advanced technology.

PSO 2: Successfully apply the principles of design, analysis and implementation of mechanical systems/processes which have been learned as a part of the curriculum.

PSO 3: Develop and implement new ideas on product design and development with the help of modern CAD/CAM tools, while ensuring best manufacturing practices.

MECHANICAL ENGINEERING	
Course Code 20MTP12	FINITE ELEMENT METHOD IN HEAT TRANSFER
CO1	Establish the mathematical models for the complex analysis problems and predict the nature of solution.
CO2	Formulate the element characteristic for linear and nonlinear matrices and vectors.
CO3	Identify the boundary conditions and their incorporation in to the FE equations.
CO4	Solve the problems with simple geometries, with hand calculations involving the fundamental concepts.
CO5	Interpret the analysis results for the improvement or modification of the system.
Course Code 20 MTP13	**ADVANCED FLUID MECHANICS**
CO1	Illustrate the basic concepts fluid flow and their governing equations
CO2	Analyse the laminar and turbulent flow problems.
CO3	Analyse one dimensional incompressible and compressible fluid flow Problems
CO4	Distinguish normal and oblique shocks and their governing Equations.
CO5	Describe the instruments and methods for flow measurements
Course Code 20MTP14	**COMBUSTION THERMODYNAMICS**
CO1	Understand the basic thermodynamic concepts for combustion phenomena.
CO2	Describe the fuel energy conversion systems.
CO3	Apply the concept of flam flow mechanism in combustion process.
CO4	knowledge of adiabatic flame temperature in the design of combustion devices.
CO5	Identify the phenomenon of flame stabilization in laminar and turbulent flames.
Course Code 20 MTP15	**ADVANCED POWER PLANT CYCLES**
CO1	Distinguish the various power plant cycle and their working principles.
CO2	Describe the working principles of different components of power plant.
CO3	Explain the concepts of power generation by nuclear power plant.
CO4	Illustrate the concept of hydroelectric power generation.
CO5	Explain the concept of pollution and its effects.

Course Code 20 MTPL16	THERMAL ENGINEERING MEASUREMENT LABORATORY
CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices.
CO2	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
CO3	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.
CO4	Identify exhaust emission, factors affecting them and report the remedies.
CO5	Determine the energy flow pattern through the hydraulic machines and I C Engine
CO6	Exhibit his competency towards preventive maintenance of IC engines.
Course Code 20RMI17	**RESEARCH METHODOLOGY AND IPR**
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.■
Course Code 20 MTP21	**ADVANCED HEAT TRANSFER**
CO1	Describe the different modes of heat transfer with both physics and the mathematical concept.
CO2	Use the concepts of radiation heat transfer for enclosure analysis.
CO3	Explain the concepts of Boundary layer.
CO4	Formulate mathematical functions for two-dimensional and three dimensional heat conduction problems.
CO5	Describe the free and forced convection problems in real time applications.
Course Code 20 MTP22	**STEAM AND GAS TURBINES**
CO1	Describe the working principles of Gas and steam turbines nozzle and diffusers.

CO2	Explain the principles of thermodynamic concept to determine the performance of steam and gas turbines.
CO3	Illustrate the concepts of axial flow and centrifugal compressors.
CO4	Differentiate axial flow and radial flow gas turbines for their analysis.
CO5	Identify the various losses associated with the turbines.
Course Code 20MTP23	**REFRIGERATION AND AIR CONDITIONING**
CO1	Understand concepts of refrigeration and air-conditioning process and systems.
CO2	Employ the theoretical principles to simple, complex vapour compression and vapour absorption refrigeration systems.
CO3	Understand conventional and alternate refrigerants and their impact on environment.
CO4	Apply the heat load calculation to design the air-conditioning systems.
CO5	Describe the concepts to design air distribution systems.
Course Code 20MTP241	**ENERGY CONSERVATION AND MANAGEMENT**
CO1	Understand the various energy conservation and improvement techniques.
CO2	Illustrate the Energy scenario.
CO3	Employ the principles of thermal engineering and energy management to improve the Performance of thermal systems.
CO4	Assess energy projects on the basis of economic and financial criteria.
CO5	Describe methods of energy production for improved utilization
Course Code 20MTP251	**SOLAR THERMAL TECHNOLOGIES AND ITS APPLICATIONS**
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.
Course Code 20 MTPL26	**SIMULATION LABORATORY**
Course Code 20MTP27	**TECHNICAL SEMINAR**
Course Code 20MTP31	**DESIGN OF HEAT TRANSFER EQUIPMENTS FOR THERMAL POWER PLANT**
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.
Course Code 20MTP322	**THEORY OF IC ENGINES**
CO1	Distinguish different Fuel-air and actual cycles.
CO2	Demonstrate the different types of injection and carburetor systems
CO3	Formulate the flow and combustion phenomenon for modeling
CO4	Identify the various types of emissions, noise and their control systems
CO5	Recommend the suitable alternative fuel for IC Engine.
Course Code 20MTP332	**NON-CONVENTIONAL ENERGY SOURCES**
CO1	Describe the need of renewable energy resources, historical and latest developments.
CO2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.
CO3	Appreciate the need of Wind Energy, wave power, tidal power, ocean thermal power and geothermal and the various components used in energy generation.
CO4	Understand the concept of Biomass energy resources and their classification, types of biogas Plants applications
Course Code 20MTP34	**PROJECT WORK PHASE – 1**
CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation, and solution.
CO3	Design engineering solutions to complex problems utilising a systems approach.
CO4	Communicate with engineers and the community at large in written an oral forms.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.
Course Code 20MTP35	**MINI PROJECT**
CO1	Present the mini-project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.

Course Code 20MTPI36	INTERNSHIP / PROFESSIONAL PRACTICE
CO1	Gain practical experience within industry in which the internship is done.
CO2	Acquire knowledge of the industry in which the internship is done.
CO3	Apply knowledge and skills learned to classroom work.
CO4	Develop a greater understanding about career options while more clearly defining personal career goals.
CO5	Experience the activities and functions of professionals.
CO6	Develop and refine oral and written communication skills.
CO7	Identify areas for future knowledge and skill development.
CO8	Expand intellectual capacity, credibility, judgment, intuition.
CO9	Acquire the knowledge of administration, marketing, finance and economics
Course Code 20MTP41	**PROJECT WORK PHASE -2**
CO1	Present the project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.

MECHANICAL ENGINEERING	
Course Code	**18EGDL15/18EGDL25 - ENGINEERING GRAPHICS AND DESIGN**
CO1	Produce computer generated drawings using CAD software.
CO2	Prepare drawings as per BIS following the conventions mentioned in the relevant codes.
CO3	Apply the knowledge of orthographic projections to represent engineering information/concepts and preset the same in the form of drawings.
CO4	Read and evaluate engineering drawings.
CO5	Create isometric drawings of simple objects reading the orthographic projections of those objects.
Course Code	**18ME15/25-ELEMENTS OF MECHANICAL ENGINEERING**
CO1	Identify different sources of energy and their conversion process.
CO2	Explain the working principle of hydraulic turbines, pumps, IC engines and refrigeration.
CO3	Recognize various metal joining processes and power transmission elements
CO4	Understand the properties of common engineering materials and their applications in engineering industry.
CO5	Discuss the working of conventional machine tools, machining processes, tools and accessories.
CO6	Describe the advanced manufacturing systems.
Course Code	**18ME32 - MECHANICS OF MATERIALS**
CO1	Understand simple, compound, thermal stresses and strains their relations and strain energy.
CO2	:Analyse structural members for stresses, strains and deformations.
CO3	Analyse the structural members subjected to bending and shear loads.
CO4	Analyse shafts subjected to twisting loads.
CO5	Analyse the short columns for stability.
Course Code	**18ME33 - BASIC THERMODYNAMICS**
CO1	Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems
CO2	Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
CO3	Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers and change in properties
CO4	. Interpret the behavior of pure substances and its application in practical problems.
CO5	Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.
Course Code	**18ME34 - MATERIAL SCIENCE**
CO1	Understand the mechanical properties of metals and their alloys.
CO2	Analyze the various modes of failure and understand the microstructures of ferrous and nonferrous materials
CO3	Describe the processes of heat treatment of various alloys.
CO4	Acquire the Knowledge of composite materials and their production process as well as applications.
CO5	Understand the properties and potentialities of various materials available and material selection procedures

Course Code	18ME35B - METAL CASTING AND WELDING
CO1	Explain the construction & specification of various machine tools.
CO2	Discuss different cutting tool materials, tool nomenclature & surface finish.
CO3	Apply mechanics of machining process to evaluate machining time.
CO4	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
CO5	Understand the concepts of different metal forming processes.
CO6	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components.
Course Code	**18ME36B - MECHANICAL MEASUREMENTS AND METROLOGY**
CO1	Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
CO2	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
CO3	Understand the working principle of different types of comparators.
CO4	Describe measurement of major & minor diameter, pitch, angle and effective diameter of screw threads.
CO5	Explain measurement systems, transducers, intermediate modifying devices and terminating devices
CO6	Describe functioning of force, torque, pressure, strain and temperature measuring devices
Course Code	**18MEL37B - MECHANICAL MEASUREMENTS AND METROLOGY LAB**
CO1	Understand Calibration of pressure gauge, thermocouple, LVDT, load cell, micrometer.
CO2	Apply concepts of Measurement of angle using Sine Centre/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
CO3	Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
CO4	Analyse tool forces using Lathe/Drill tool dynamometer.
CO5	Analyse Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth Vernier/Gear tooth micrometre
CO6	Understand the concepts of measurement of surface roughness.
Course Code	**18MEL38B - FOUNDRY, FORGING AND WELDING LAB**
CO1	Demonstrate various skills in preparation of molding sand for conducting tensile, shear and compression tests using Universal sand testing machine.
CO2	Demonstrate skills in determining permeability, clay content and Grain Fineness Number of base sands.
CO3	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.
Course Code	**18ME42 - APPLIED THERMODYNAMICS**
CO1	Apply thermodynamic concepts to analyze the performance of gas power cycles.
CO2	Apply thermodynamic concepts to analyze the performance of vapour power cycles.
CO3	Understand combustion of fuels and performance of I C engines.
CO4	Understand the principles and applications of refrigeration systems.
CO5	Apply Thermodynamic concepts to determine performance parameters of refrigeration and air conditioning systems.
CO6	Understand the working principle of Air compressors and Steam nozzles, applications, relevance of air and identify methods for performance improvement.

Course Code	18ME43 - FLUID MECHANICS
CO1	Identify and calculate the key fluid properties used in the analysis of fluid behavior.
CO2	Explain the principles of pressure, buoyancy and floatation
CO3	Apply the knowledge of fluid statics, kinematics and dynamics while addressing problems of mechanical and chemical engineering.
CO4	Describe the principles of fluid kinematics and dynamics.
CO5	Explain the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
CO6	Illustrate and explain the basic concept of compressible flow and CFD
Course Code	**18ME44 - KINEMATICS OF MACHINES**
CO1	Knowledge of mechanisms and their motion.
CO2	Analyse the velocity, acceleration of links and joints of mechanisms.
CO3	Analysis of cam follower motion for the motion specifications.
CO4	Understand the working of the spur gears.
CO5	Analyse the gear trains speed ratio and torque.
CO6	Understand the inversions of four bar mechanisms.
Course Code	**18ME45A - METAL CUTTING AND FORMING**
CO1	Explain the construction & specification of various machine tools
CO2	Discuss different cutting tool materials, tool nomenclature & surface finish.
CO3	Apply mechanics of machining process to evaluate machining time.
CO4	Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
CO5	Understand the concepts of different metal forming processes.
CO6	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components.
Course Code	**18ME46A - COMPUTER AIDED MACHINE DRAWING**
CO1	Identify the national and international standards pertaining to machine drawing.
CO2	Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
CO3	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
CO4	Interpret the Machining and surface finish symbols on the component drawings.
CO5	Preparation of the part or assembly drawings as per the conventions.
Course Code	**18MEL47A - MATERIAL TESTING LAB**
CO1	Acquire experimentation skills in the field of material testing.
CO2	Develop theoretical understanding of the mechanical properties of materials by performing experiments.
CO3	Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
CO4	Apply the knowledge of testing methods in related areas.

CO5	Understand how to improve structure/behavior of materials for various industrial applications.
Course Code	**18MEL48A - WORKSHOP AND MACHINE SHOP PRACTICE**
CO1	To read working drawings, understand operational symbols and execute machining operations.
CO2	Prepare fitting models according to drawings using hand tools- V-block, marking gauge, files, hack saw, drills etc.
CO3	Understand integral parts of lathe, shaping and milling machines and various accessories and attachments used.
CO4	Select cutting parameters like cutting speed, feed, depth of cut, and tooling for various machining operations.
CO5	Perform cylindrical turning operations such as plain turning, taper turning, step turning, thread Cutting, facing, knurling, internal thread cutting, eccentric turning and estimate cutting time.
CO6	Perform machining operations such as plain shaping, inclined shaping, keyway cutting, Indexing and Gear cutting and estimate cutting time.
Course Code	**18ME51 - MANAGEMENT AND ECONOMICS**
CO1	Understand needs, functions, roles, scope and evolution of Management
CO2	Understand importance, purpose of Planning and hierarchy of planning and also54nalyse its types.
CO3	Discuss Decision making, Organizing, Staffing, Directing and Controlling.
CO4	Select the best economic model from various available alternatives.
CO5	Understand various interest rate methods and implement the suitable one.
CO6	Estimate various depreciation values of commodities.
CO7	Prepare the project reports effectively.
Course Code	**18ME52 - DESIGN OF MACHINE ELEMENTS I**
CO1	Apply the concepts of selection of materials for given mechanical components.
CO2	List the functions and uses of machine elements used in mechanical systems.
CO3	Apply codes and standards in the design of machine elements and select an element based on the Manufacturer's catalogue.
CO4	Analyze the performance and failure modes of mechanical components subjected to combined loading and fatigue loading using the concepts of theories of failure.
CO5	Demonstrate the application of engineering design tools to the design of machine components like shafts, couplings, power screws, fasteners, welded and riveted joints
CO6	Understand the art of working in a team.
Course Code	**18ME53 - DYNAMICS OF MACHINES**
CO1	Analyse the mechanisms for static and dynamic equilibrium.
CO2	Carry out the balancing of rotating and reciprocating masses
CO3	Analyse different types of governors used in real life situation.
CO4	Analyse the gyroscopic effects on disks, airplanes, stability of ships, two and four wheelers
CO5	Understand the free and forced vibration phenomenon.
CO6	Determine the natural frequency, force and motion transmitted in vibrating systems.
Course Code	**18ME54 - TURBO MACHINES**
CO1	CO1: Model studies and thermodynamics analysis of turbomachines.

CO2	Analyse the energy transfer in Turbo machine with degree of reaction and utilisation factor.
CO3	Classify, analyse and understand various type of steam turbine.
CO4	Classify, analyse and understand various type of hydraulic turbine.
CO5	Understand the concept of radial power absorbing machine and the problems involved during its operation.
Course Code	**18ME55 - FLUID POWER ENGINEERING**
CO1	CO1: Identify and analyse the functional requirements of a fluid power transmission system for a given application.
CO2	Visualize how a hydraulic/pneumatic circuit will work to accomplish the function.
CO3	Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro-hydraulics, electro- pneumatics for a given application.
CO4	Select and size the different components of the circuit.
CO5	Develop a comprehensive circuit diagram by integrating the components selected for the given application.
Course Code	**18ME56 - OPERATIONS MANAGEMENT**
CO1	Explain the concept and scope of operations management in a business context
CO2	Recognize the role of Operations management among various business functions and its role in the organizations' strategic planning and gaining competitive advantage
CO3	Analyze the appropriateness and applicability of a range of operations management systems/models in decision making.
CO4	Assess a range of strategies for improving the efficiency and effectiveness of organizational operations.
CO5	Evaluate a selection of frameworks used in the design and delivery of operations
Course Code	**18MEL57 - FLUID MECHANICS AND MACHINES LAB**
CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices.
CO2	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
CO3	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.
CO4	Determine the energy flow pattern through the hydraulic turbines and pumps.
CO5	Exhibit his competency towards preventive maintenance of hydraulic machines.
Course Code	**18MEL58 - ENERGY CONVERSION LABORATORY**
CO1	Perform experiments to determine the properties of fuels and oils.
CO2	Conduct experiments on engines and draw characteristics
CO3	Test basic performance parameters of I.C. Engine and implement the knowledge in industry.
CO4	Identify exhaust emission, factors affecting them and exhibit his competency towards preventive maintenance of IC engines.
Course Code	**18MEL59 - ENVIRONMENTAL STUDIES**
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale
CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
CO4	Apply their ecological knowledge to illustrate an and graph a problem and describe the realities that managers face when dealing with complex issues.

Course Code	18ME61 - FINITE ELEMENT METHODS
CO1	Identify the application and characteristics of FEA elements such as bars, beams, plane and isoparametric elements.
CO2	Develop element characteristic equation and generation of global equation.
CO3	Formulate and solve Axi-symmetric and heat transfer problems.
CO4	Apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi-symmetric and dynamic problems
Course Code	**18ME62 - DESIGN OF MACHINE ELEMENTS II**
CO1	Apply design principles for the design of mechanical systems involving springs, belts, pulleys, and wire ropes.
CO2	Design different types of gears and simple gear boxes for relevant applications.
CO3	Understand the design principles of brakes and clutches.
CO4	Apply design concepts of hydrodynamic bearings for different applications and select Anti friction bearings for different applications using the manufacturers, catalogue
CO5	Apply engineering design tools to product design.
CO6	Become good design engineers through learning the art of working in a team.
Course Code	**18ME63 - HEAT TRANSFER**
CO1	Understand the modes of heat transfer and apply the basic laws to formulate engineering systems.
CO2	Understand and apply the basic laws of heat transfer to extended surface, composite material and unsteady state heat transfer problems.
CO3	Analyze heat conduction through numerical methods and apply the fundamental principle to solve radiation heat transfer problems.
CO4	Analyze heat transfer due to free and forced convective heat transfer.
CO5	Understand the design and performance analysis of heat exchangers and their practical applications, Condensation and Boiling phenomena
Course Code	**18ME641 - NON-TRADITIONAL MACHINING**
CO1	Understand the compare traditional and non-traditional machining process and recognize the need for Non- traditional machining process.
CO2	Understand the constructional features, performance parameters, process characteristics, applications, advantages and limitations of USM, AJM and WJM.
CO3	Identify the need of Chemical and electro-chemical machining process along with the constructional features, process parameters, process characteristics, applications, advantages and limitations.
CO4	Understand the constructional feature of the equipment, process parameters, process characteristics, applications, advantages and limitations EDM & PAM.
CO5	Understand the LBM equipment, LBM parameters, and characteristics. EBM equipment and mechanism of metal removal, applications, advantages and limitations LBM & EBM.
Course Code	**18ME653 - RENEWABLE ENERGY RESOURCES (OPEN ELECTIVE)**
CO1	Discuss causes of energy scarcity and its solution, energy resources and availability of renewable energy.
CO2	Outline energy from sun, energy reaching the Earth's surface and solar thermal energy applications.
CO3	Discuss types of solar collectors, their configurations, solar cell system, its characteristics and their applications.
CO4	Explain generation of energy from hydrogen, wind, geothermal system, solid waste and agriculture refuse.
CO5	Discuss production of energy from biomass, biogas.
CO6	Summarize tidal energy resources, sea wave energy and ocean thermal energy.

Course Code	18MEL66 - COMPUTER AIDED MODELLING AND ANALYSIS LAB
CO1	Use the modern tools to formulate the problem, create geometry, descritize, apply boundary conditions to solve problems of bars, truss, beams, and plate to find stresses with different-loading conditions.
CO2	Demonstrate the ability to obtain deflection of beams subjected to point, uniformly distributed and varying loads and use the available results to draw shear force and bending moment diagrams.
CO3	Analyze and solve 1D and 2D heat transfer conduction and convection problems with different boundary conditions.
CO4	Carry out dynamic analysis and finding natural frequencies of beams, plates, and bars for various boundary conditions and also carry out dynamic analysis with forcing functions.
Course Code	**18MEL67 - HEAT TRANSFER LAB**
CO1	Determine the thermal conductivity of a metal rod and overall heat transfer coefficient of composite slabs.
CO2	Determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
CO3	Evaluate temperature distribution characteristics of steady and transient heat conduction through solid cylinder experimentally.
CO4	Determine surface emissivity of a test plate and Stefan Boltzmann constant
CO5	Estimate performance of a refrigerator and effectiveness of a fin and Double pipe heat exchanger
Course Code	**18ME71 - CONTROL ENGINEERING**
CO1	Identify the type of control and control actions.
CO2	Develop the mathematical model of the physical systems.
CO3	Estimate the response and error in response of first and second order systems subjected standard input signals.
CO4	Represent the complex physical system using block diagram and signal flow graph and obtain transfer function
CO5	Analyse a linear feedback control system for stability using Hurwitz criterion, Routh's criterion and root Locus technique in complex domain.
Course Code	**18ME72 - COMPUTER AIDED DESIGN AND MANUFACTURING**
CO1	CO1: Define Automation, CIM, CAD, CAM and explain the differences between these concepts. Solve simple problems of transformations of entities on computer screen
CO2	Explain the basics of automated manufacturing industries through mathematical models and analyzedifferent types of automated flow lines.
CO3	Analyse the automated flow lines to reduce time and enhance productivity.
CO4	Explain the use of different computer applications in manufacturing, and able to prepare part programs for simple jobs on CNC machine tools and robot programming.
CO5	Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing.
Course Code	**18ME732 - AUTOMATION & ROBOTICS**
CO1	Translate and simulate a real time activity using modern tools and discuss the Benefits of automation.
CO2	Identify suitable automation hardware for the given application
CO3	Recommend appropriate modelling and simulation tool for the given manufacturing Application.
CO4	Explain the basic principles of Robotic technology, configurations, control and Programming of Robots.
CO5	Explain the basic principles of programming and apply it for typical Pick & place, Loading & unloading and palletizing applications
Course Code	**18ME741 - ADDITIVE MANUFACTURING**

CO1	Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials that are available.
CO2	Demonstrate the knowledge of the broad range of AM processes, devices, capabilities and materials that are available.
CO3	Understand the various software tools, processes and techniques that enable advanced/additive manufacturing.
CO4	Apply the concepts of additive manufacturing to design and create components that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.
CO5	Understand characterization techniques in additive manufacturing.
CO6	Understand the latest trends and business opportunities in additive manufacturing.
Course Code	**18ME753 - DISASTERS MANAGEMENT (OPEN ELECTIVE)**
CO1	Discuss disaster management plan, cyclones and their hazard potential
CO2	Understand the role of IMD and cyclone prediction and cyclone warning system in India
CO3	Understand the role of different institutions defence and other services in natural disaster management
CO4	Understand the role of Central Water Commission in river water sharing, Draught, its assessment and draught management plan
CO5	Understand occurrence of earth quake, Tsunamis and thunderstorms.
Course Code	**18MEL76 - COMPUTRE AIDED MANUFACTURING LAB**
Course Code	**18MEL77 - DESIGN LAB**
CO1	Compute the natural frequency of the free and forced vibration of single degree freedom systems, critical speed of shafts.
CO2	Carry out balancing of rotating masses
CO3	Analyse the governor characteristics.
CO4	Determine stresses in disk, beams, plates and hook using photo elastic bench.
CO5	Determination of Pressure distribution in Journal bearing
CO6	Analyse the stress and strains using strain gauges in compression and bending test and stress distribution in curved beams.
Course Code	**18ME81 - ENERGY ENGINEERING**
CO1	Understand the construction and working of steam generators and their accessories.
CO2	Identify renewable energy sources and their utilization.
CO3	Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, nuclear, hydel and tidal.
Course Code	**18ME822 - TRIBOLOGY**
CO1	Understand the fundamentals of tribology and associated parameters.
CO2	Apply concepts of tribology for the performance analysis and design of components experiencing relative motion
CO3	Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.
CO4	Select proper bearing materials and lubricants for a given tribological application.
CO5	Apply the principles of surface engineering for different applications of tribology.

MECHANICAL ENGINEERING	
Course Code 20MTP12	FINITE ELEMENT METHOD IN HEAT TRANSFER
CO1	Establish the mathematical models for the complex analysis problems and predict the nature of solution.
CO2	Formulate the element characteristic for linear and nonlinear matrices and vectors.
CO3	Identify the boundary conditions and their incorporation in to the FE equations.
CO4	Solve the problems with simple geometries, with hand calculations involving the fundamental concepts.
CO5	Interpret the analysis results for the improvement or modification of the system.
Course Code 20 MTP13	**ADVANCED FLUID MECHANICS**
CO1	Illustrate the basic concepts fluid flow and their governing equations
CO2	Analyse the laminar and turbulent flow problems.
CO3	Analyse one dimensional incompressible and compressible fluid flow Problems
CO4	Distinguish normal and oblique shocks and their governing Equations.
CO5	Describe the instruments and methods for flow measurements
Course Code 20MTP14	**COMBUSTION THERMODYNAMICS**
CO1	Understand the basic thermodynamic concepts for combustion phenomena.
CO2	Describe the fuel energy conversion systems.
CO3	Apply the concept of flam flow mechanism in combustion process.
CO4	knowledge of adiabatic flame temperature in the design of combustion devices.
CO5	Identify the phenomenon of flame stabilization in laminar and turbulent flames.
Course Code 20 MTP15	**ADVANCED POWER PLANT CYCLES**
CO1	Distinguish the various power plant cycle and their working principles.
CO2	Describe the working principles of different components of power plant.
CO3	Explain the concepts of power generation by nuclear power plant.
CO4	Illustrate the concept of hydroelectric power generation.
CO5	Explain the concept of pollution and its effects.

Course Code 20 MTPL16	THERMAL ENGINEERING MEASUREMENT LABORATORY
CO1	Perform experiments to determine the coefficient of discharge of flow measuring devices.
CO2	Conduct experiments on hydraulic turbines and pumps to draw characteristics.
CO3	Test basic performance parameters of hydraulic turbines and pumps and execute the knowledge in real life situations.
CO4	Identify exhaust emission, factors affecting them and report the remedies.
CO5	Determine the energy flow pattern through the hydraulic machines and I C Engine
CO6	Exhibit his competency towards preventive maintenance of IC engines.
Course Code 20RMI17	**RESEARCH METHODOLOGY AND IPR**
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.■
Course Code 20 MTP21	**ADVANCED HEAT TRANSFER**
CO1	Describe the different modes of heat transfer with both physics and the mathematical concept.
CO2	Use the concepts of radiation heat transfer for enclosure analysis.
CO3	Explain the concepts of Boundary layer.
CO4	Formulate mathematical functions for two-dimensional and three dimensional heat conduction problems.
CO5	Describe the free and forced convection problems in real time applications.
Course Code 20 MTP22	**STEAM AND GAS TURBINES**
CO1	Describe the working principles of Gas and steam turbines nozzle and diffusers.

CO2	Explain the principles of thermodynamic concept to determine the performance of steam and gas turbines.
CO3	Illustrate the concepts of axial flow and centrifugal compressors.
CO4	Differentiate axial flow and radial flow gas turbines for their analysis.
CO5	Identify the various losses associated with the turbines.
Course Code 20MTP23	**REFRIGERATION AND AIR CONDITIONING**
CO1	Understand concepts of refrigeration and air-conditioning process and systems.
CO2	Employ the theoretical principles to simple, complex vapour compression and vapour absorption refrigeration systems.
CO3	Understand conventional and alternate refrigerants and their impact on environment.
CO4	Apply the heat load calculation to design the air-conditioning systems.
CO5	Describe the concepts to design air distribution systems.
Course Code 20MTP241	**ENERGY CONSERVATION AND MANAGEMENT**
CO1	Understand the various energy conservation and improvement techniques.
CO2	Illustrate the Energy scenario.
CO3	Employ the principles of thermal engineering and energy management to improve the Performance of thermal systems.
CO4	Assess energy projects on the basis of economic and financial criteria.
CO5	Describe methods of energy production for improved utilization
Course Code 20MTP251	**SOLAR THERMAL TECHNOLOGIES AND ITS APPLICATIONS**
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.
Course Code 20 MTPL26	**SIMULATION LABORATORY**
Course Code 20MTP27	**TECHNICAL SEMINAR**
Course Code 20MTP31	**DESIGN OF HEAT TRANSFER EQUIPMENTS FOR THERMAL POWER PLANT**
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.
Course Code 20MTP322	**THEORY OF IC ENGINES**
CO1	Distinguish different Fuel-air and actual cycles.
CO2	Demonstrate the different types of injection and carburetor systems
CO3	Formulate the flow and combustion phenomenon for modeling
CO4	Identify the various types of emissions, noise and their control systems
CO5	Recommend the suitable alternative fuel for IC Engine.
Course Code 20MTP332	**NON-CONVENTIONAL ENERGY SOURCES**
CO1	Describe the need of renewable energy resources, historical and latest developments.
CO2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation, drying, cooking etc.
CO3	Appreciate the need of Wind Energy, wave power, tidal power, ocean thermal power and geothermal and the various components used in energy generation.
CO4	Understand the concept of Biomass energy resources and their classification, types of biogas Plants applications
Course Code 20MTP34	**PROJECT WORK PHASE – 1**
CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation, and solution.
CO3	Design engineering solutions to complex problems utilising a systems approach.
CO4	Communicate with engineers and the community at large in written an oral forms.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.
Course Code 20MTP35	**MINI PROJECT**
CO1	Present the mini-project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.

Course Code 20MTPI36	INTERNSHIP / PROFESSIONAL PRACTICE
CO1	Gain practical experience within industry in which the internship is done.
CO2	Acquire knowledge of the industry in which the internship is done.
CO3	Apply knowledge and skills learned to classroom work.
CO4	Develop a greater understanding about career options while more clearly defining personal career goals.
CO5	Experience the activities and functions of professionals.
CO6	Develop and refine oral and written communication skills.
CO7	Identify areas for future knowledge and skill development.
CO8	Expand intellectual capacity, credibility, judgment, intuition.
CO9	Acquire the knowledge of administration, marketing, finance and economics
Course Code 20MTP41	**PROJECT WORK PHASE -2**
CO1	Present the project and be able to defend it.
CO2	Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
CO3	Habituated to critical thinking and use problem solving skills
CO4	Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
CO5	Work in a team to achieve common goal.
CO6	Learn on their own, reflect on their learning and take appropriate actions to improve it.

COURSE: TRANSFORM CALCULUS , FOURIER SERIES AND NUMERICAL METHODS

COURSE CODE:18MAT31

SEMESTER: III

SCHEME: 2018

Course outcomes: At the end of the course the student will be able to:

• **CO1:** Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.

• **CO2:** Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.

• **CO3:** Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.

•**CO4:** Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.

• **CO5:**Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

SUBJECT: COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS

SUBJECT CODE:18MAT41

SCHEME:2018

SEMESTER: IV

Course outcomes: At the end of the course the student will be able to:

CO1 :Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.

CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.

CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.

CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.

CO5: Construct joint probability distributions and demonstrate the validity of testing the hypothesis.