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<th>Sl. No.</th>
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</table>
2. Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.  
3. Employ appropriate numerical methods to solve algebraic and transcendental equations.  
4. Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electromagnetic and gravitational fields and fluid flow problems.  
5. Determine the extremals of functionals and solve the simple problems of the calculus of variations. |
| 2.     | Electronic Instrumentation | 17EC32 | 1. Describe instrument measurement errors and calculate them.  
2. Describe the operation of Ammeters, Voltmeters, Multimeters and develop circuits for multirange Ammeters and Voltmeters.  
3. Describe functional concepts and operation of Digital voltmeters and instruments to measure voltage, frequency, time period, phase difference of signals, rotation speed, capacitance and pH of solutions.  
4. Describe functional concepts and operation of various Analog measuring instruments to measure output power, field strength, impedance, stroboscopic speed, in/out of phase, Q of coils, insulation resistance and pH.  
5. Describe and discuss functioning and types of Oscilloscopes, Signal generators and Transducers.  
6. Utilize AC and DC bridges for passive component and frequency measurements |
| 3.     | Analog Electronics | 17EC33 | 1. Describe the working principle and characteristics of BJT, FET, Single stage, cascaded and feedback amplifiers.  
2. Describe the Phase shift, Wien Bridge, tuned and crystal oscillators using BJT/FET/UJT.  
3. Calculate the AC gain and impedance for BJT using re and h parameters models for CE and CC configuration.  
4. Determine the performance characteristics and parameters of BJT and FET amplifier using small signal model.  
5. Determine the parameters which affect the low frequency and high frequency responses of BJT and FET amplifiers and draw the characteristics.  
6. Evaluate the efficiency of Class A and Class B power amplifiers and voltage regulators. |
2. Explain the operation of decoders, encoders, multiplexers, demultiplexers, adders, subtractors and comparators.  
3. Explain the working of Latches and Flip Flops (SR, D, T and JK).  
5. Develop Mealy/Moore Models and state diagrams for the given clocked sequential circuits.  
6. Apply the knowledge gained in the design of Counters and Registers. |
| 5.     | Network Analysis | 17EC34 | 1. Determine currents and voltages using source transformation/source shifting/mesh/nodal analysis and reduce given network using star-delta transformation/source transformation/source shifting.  
2. Solve network problems by applying Superposition/Reciprocity/Thévenin’s/Norton’s/ Maximum Power Transfer/Millman’s Network Theorems and electrical laws to reduce circuit complexities and to arrive at feasible solutions.  
3. Calculate current and voltages for the given circuit under transient conditions.  
4. Apply Laplace transform to solve the given network.  
5. Evaluate for RLC elements/frequency response related parameters like resonant frequency, quality factor, half power frequencies, voltage across inductor and capacitor, current through the RLC elements, in resonant circuits.  
6. Solve the given network using specified two port network parameter like Z or Y or T or h.  
7. |
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<tr>
<th></th>
<th>Course Title</th>
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<tbody>
<tr>
<td>6</td>
<td>Engineering Electromagnetics</td>
<td>17EC36</td>
<td>1. Evaluate problems on electric field due to point, linear, volume charges by applying conventional methods or by Gauss law.</td>
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<td>2. Determine potential and energy with respect to point charge and capacitance using Laplace equation.</td>
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<td>3. Calculate magnetic field, force, and potential energy with respect to magnetic materials.</td>
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<td>4. Apply Maxwell’s equation for time varying fields, EM waves in free space and conductors.</td>
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<td>5. Evaluate power associated with EM waves using Poynting theorem.</td>
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<tr>
<td>7</td>
<td>Additional Mathematics - I</td>
<td>17MATDIP31</td>
<td>1. Understand the fundamental concepts of complex numbers and vector algebra to analyze the problems arising in related area.</td>
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<td>2. Use derivatives and partial derivatives to calculate rates of change of multivariate functions.</td>
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<td>3. Learn techniques of integration including double and triple integrals to find area, volume, mass and moment of inertia of plane and solid region.</td>
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<td>4. Analyze position, velocity and acceleration in two or three dimensions using the calculus of vector valued functions.</td>
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<td>5. Recognize and solve first-order ordinary differential equations occurring in different branches of engineering.</td>
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<td>8</td>
<td>Kannada/Constitution of India, Professional Ethics and Human Rights</td>
<td>17KL/CPH39/49</td>
<td>1. Evaluate problems on electric field due to point, linear, volume charges by applying conventional methods or by Gauss law.</td>
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# Course Outcomes for 2017-18

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2. Understand the analyticity, potential fields, residues and poles of complex potentials in field theory and electromagnetic theory.  
3. Describe conformal and bilinear transformation arising in aero foil theory, fluid flow visualization and image processing.  
4. Solve problems of quantum mechanics, hydrodynamics and heat conduction by employing Bessel's function relating to cylindrical polar coordinate systems and Legendre’s polynomials relating to spherical polar coordinate systems.  
5. Solve problems on probability distributions relating to digital signal processing, information theory and optimization concepts of stability of design and structural engineering.  
6. Draw the validity of the hypothesis proposed for the given sampling distribution in accepting or rejecting the hypothesis.  
7. Determine joint probability distributions and stochastic matrix connected with the multivariable correlation problems for feasible random events.  
8. Define transition probability matrix of a Markov chain and solve problems related to discrete parameter random process. |
| 2.     | Signals and Systems          | 17EC42       | 1. Classify the signals as continuous/discrete, periodic/aperiodic, even/odd, energy/power and deterministic/random signals.  
2. Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.  
3. Compute the response of a Continuous and Discrete LTI system using convolution Integral and convolution sum.  
4. Determine the spectral characteristics of continuous and discrete time signal using Fourier analysis.  
5. Compute Z-transforms, inverse Z-transforms and transfer functions of complex LTI systems. |
| 3.     | Control Systems              | 17EC43       | 1. Develop the mathematical model of mechanical and electrical systems  
2. Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method.  
3. Determine the time domain specifications for first and second order systems  
4. Determine the stability of a system in the time domain using Routh-Hurwitz criterion and Root-locus technique.  
5. Determine the stability of a system in the frequency domain using Nyquist and bode plots  
6. Develop a control system model in continuous and discrete time using state variable techniques. |
2. Determine the performance of systems for generation and detection of modulated analog signals.  
3. Characterize analog signals in time domain as random processes and in frequency domain using Fourier transforms.  
4. Characterize the influence of channel on analog modulated signals  
5. Determine the performance of analog communication systems.  
6. Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems. |
| 5.     | Linear Integrated Circuits   | 17EC45       | 1. Explain Op-Amp circuit and parameters including CMRR, PSRR, Input & Output Impedances and Slew Rate.  
6. Explain applications of linear ICs in phase detector, VCO, DAC, ADC and Timer. |
2. Write 8086 Assembly level programs using the 8086 instruction set  
3. Write modular programs using procedures and macros. |
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<td>4.</td>
<td>Write 8086 Stack and Interrupts programming&lt;br&gt;5. Interface 8086 to Static memory chips and 8255, 8254, 0808 ADC, 0800 DAC, Keyboard, Display and Stepper motors.&lt;br&gt;6. Use INT 21 DOS interrupt function calls to handle Keyboard and Display.</td>
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<td>7.</td>
<td>Additional Mathematics - II</td>
<td>17MATDIP41</td>
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<td>1. Solve systems of linear equations in the different areas of linear algebra.&lt;br&gt;2. Solve second and higher order differential equations occurring in electrical circuits, damped/un-damped vibrations.&lt;br&gt;3. Describe Laplace transforms of standard and periodic functions.&lt;br&gt;4. Determine the generalCOMPLETE solutions to linear ODE using inverse Laplace transforms.&lt;br&gt;5. Recall basic concepts of elementary probability theory and, solve problems related to the decision theory, synthesis and optimization of digital circuits.</td>
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17 CV32-STRENGTH OF MATERIALS

Course Objectives: This course will enable students;
1. To understand the basic concepts of the stresses and strains for different materials and strength of structural elements.
2. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements.
3. To analyse and understand different internal forces and stresses induced due to representative loads on structural elements.
4. To analyse and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
5. To evaluate the behavior of torsional members, columns and struts.

Course outcomes: After studying this course, students will be able;
1. To evaluate the strength of various structural elements internal forces such as compression, tension, shear, bending and torsion.
2. To suggest suitable material from among the available in the field of construction and manufacturing.
3. To evaluate the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.
4. To understand the basic concept of analysis and design of members subjected to torsion.
5. To understand the basic concept of analysis and design of structural elements such as columns and struts.

17 CV33-FLUIDS MECHANICS

Course Objectives: The objectives of this course is to make students to learn:
1. The Fundamental properties of fluids and its applications.
2. Hydrostatic laws and application to practical problem solving
3. Principles of Kinematics and Hydro-Dynamics for practical applications
4. Basic design of pipes and pipe networks considering flow, pressure and its losses.
5. The basic flow rate measurements

Course outcomes: After successful completion of the course, the student will be able to:
1. Possess a sound knowledge of fundamental properties of fluids and fluid continuum
2. Compute and solve problems on hydrostatics, including practical applications
3. Apply principles of mathematics to represent kinematic concepts related to fluid flow
4. Apply fundamental laws of fluid mechanics and the Bernoulli’s principle for practical applications
5. Compute the discharge through pipes and over notches and weirs

**17 CV34-BASIC SURVEYING**

**Course Objectives:** This course will enable students to;
1. Understand the basic principles of Surveying
2. Learn Linear and Angular measurements to arrive at solutions to basic surveying problems.
3. Employ conventional surveying data capturing techniques and process the data for computations.
4. Analyze the obtained spatial data to compute areas and volumes and draw contours to represent 3D data on plane figures.

**Course outcomes:** After a successful completion of the course, the student will be able to:
1. Posses a sound knowledge of fundamental principles Geodetics
2. Measurement of vertical and horizontal plane, linear and angular dimensions to arrive at solutions to basic surveying problems.
3. Capture geodetic data to process and perform analysis for survey problems.
4. Analyse the obtained spatial data and compute areas and volumes. Represent 3D data on plane figures as contours

**17 CV35-ENGINEERING GEOLOGY**

**Course Objectives:** This course will enable students;
1. To understand the internal structure and composition of the earth.
2. To comprehend the properties, occurrence and uses of minerals in various industries.
3. To learn about geo-morphological agents such as river, wind, sea waves, and their implications in implementing civil engineering projects.
4. To gain knowledge about the structures of the rocks and their considerations in the selection of site for dams, tunnels, bridges and highways.
5. To learn the application of Topographic maps, remote sensing and GIS in Civil engineering practices and natural resource management.
Course outcomes: After a successful completion of the course, the student will be able to:
1. Students will able to apply the knowledge of geology and its role in Civil Engineering
2. Students will effectively utilize earth’s materials such as mineral, rocks and water in civil engineering practices.
3. Analyze the natural disasters and their mitigation.
4. Assess various structural features and geological tools in ground water exploration, Natural resource estimation and solving civil engineering problems.
5. Apply and assess use of building materials in construction and assess their Properties

17 CV36-Building Materials and Construction

Course Objectives: This course will develop a student;
1. In recognizing the good materials to be used for the construction work
2. In investigation of soil condition, Deciding and design of suitable foundation for different structures
3. In supervision of different types of masonry
4. In selection of materials, design and supervision of suitable type of floor and roof.
5. To gain knowledge about doors, windows, plastering, painting, damp proofing, scaffolding, shoring, underpinning and to take suitable engineering measures.

Course outcomes: After a successful completion of the course, the student will be able to:
1. Select suitable materials for buildings and adopt suitable construction techniques.
2. Adopt suitable repair and maintenance work to enhance durability of buildings.

17CVL37-BUILDING MATERIALS TESTING LABORATORY

Course Objectives: The objectives of this course is to make students to learn:
1. Ability to apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials.
2. Ability to function on multi-disciplinary teams in the area of materials testing.
3. Ability to use the techniques, skills and modern engineering tools necessary for engineering.
4. Understanding of professional and ethical responsibility in the areas of
material testing.
5. Ability to communicate effectively the mechanical properties of materials.

**Course outcomes:** After successful completion of the course, the students will be able to:
1. Reproduce the basic knowledge of mathematics and engineering in finding the strength in tension, compression, shear and torsion.
2. Identify, formulate and solve engineering problems of structural elements subjected to flexure.
3. 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.

**17CVL38-BASIC SURVEYING PRACTICE**

**Course Objectives:** The objectives of this course is to make students to:
1. Apply the basic principles of engineering surveying and measurements
2. Follow effectively field procedures required for a professional surveyor
3. Use techniques, skills and conventional surveying instruments necessary for engineering practice.

**Course outcomes:** After a successful completion of the course, the student will be able to:
1. Apply the basic principles of engineering surveying for linear and angular measurements.
2. Comprehend effectively field procedures required for a professional surveyor.
3. Use techniques, skills and conventional surveying instruments necessary for engineering practice.

**4th SEM**

**17 CV42-Analysis of Determinate Structures**

**Course Objectives:** This course will enable students to
1. Apply knowledge of mathematics and engineering in calculating slope and deflections
2. Identify, formulate and solve engineering problems
3. Analyse structural systems and interpret data
4. Engage in lifelong learning with the advances in Structural Engineering

**Course outcomes:** After studying this course, students will be able to:
1. Evaluate the forces in determinate trusses by method of joints and sections.
2. Evaluate the deflection of cantilever, simply supported and overhanging beams by different methods.
3. Understand the energy principles and energy theorems and its applications to determine the deflections of trusses and bent frames.
4. Determine the stress resultants in arches and cables.
5. Understand the concept of influence lines and construct the ILD diagram for the moving loads.

17 CV43-Applied Hydraulics

**Course Objectives:** The objectives of this course is to make students to learn:
1. Principles of dimensional analysis to design hydraulic models and Design of various models.
2. Design the open channels of various cross sections including design of economical sections.
3. Energy concepts of fluid in open channel, Energy dissipation, Water surface profiles at different conditions.
4. The working principles of the hydraulic machines for the given data and analyzing the performance of Turbines for various design data.

**Course outcomes:**
After a successful completion of the course, the student will be able to:
1. Apply dimensional analysis to develop mathematical modeling and compute the parametric values in prototype by analyzing the corresponding model parameters.
2. Design the open channels of various cross sections including economical channel sections.
3. Apply Energy concepts to flow in open channel sections, Calculate Energy dissipation,
4. Compute water surface profiles at different conditions.
5. Design turbines for the given data, and to know their operation characteristics under different operating conditions.

17 CV44-Concrete Technology

**Course objectives:** This course will enable students to:
1. Recognize the importance of material characteristics and their contributions to strength development in Concrete.
2. Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete.
3. Ascertained and measure engineering properties of concrete in fresh and hardened state which meet the requirement of real time structures.

**Course outcomes:**
After studying this course, students will be able to:

1. Relate material characteristics and their influence on microstructure of concrete.
2. Distinguish concrete behaviour based on its fresh and hardened properties.
3. Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes.

**17 CV45-Basic Geotechnical Engineering**

**Course Objectives:** This course will enable students
1. To appreciate basic concepts of soil mechanics as an integral part in the knowledge of civil engineering. Also to become familiar broadly with geotechnical engineering problems such as, foundation engineering, flow of water through soil medium and terminologies associated with geotechnical engineering.
2. To know the basic engineering properties and the mechanical behaviour of different types of soil. This includes strength-deformation characteristics under shearing stresses. Also consolidation properties of clayey soils.
3. To determine the improvement in mechanical behaviour by densification of soil deposits using compaction.
4. To know how the properties of soils that can be measured in the lab

**Course outcomes:**
On the completion of this course students are expected to attain the following outcomes;

1. Will acquire an understanding of the procedures to determine index properties of any type of soil, classify the soil based on its index properties
2. Will be able to determine compaction characteristics of soil and apply that knowledge to assess field compaction procedures
3. Will be able to determine permeability property of soils and acquires conceptual knowledge about stresses due to seepage and effective stress; Also acquire ability to estimate seepage losses across hydraulic structure
4. Will be able to estimate shear strength parameters of different types of soils using the data of different shear tests and comprehend Mohr-Coulomb failure theory.
5. Ability to solve practical problems related to estimation of consolidation settlement of soil deposits also time required for the same.
17 CV46-Advanced Surveying

**Course Objectives:** This course will enable students to:
1. Apply geometric principles to arrive at solutions to surveying problems.
2. Analyze spatial data using appropriate computational and analytical techniques.
3. Design proper types of curves for deviating type of alignments.
4. Use the concepts of advanced data capturing methods necessary for engineering Practice

**Course outcomes:** After a successful completion of the course, the student will be able to:
1. Apply the knowledge of geometric principles to arrive at surveying problems
2. Use modern instruments to obtain geo-spatial data and analyse the same to appropriate engineering problems.
3. Capture geodetic data to process and perform analysis for survey problems with the use of electronic instruments;
4. Design and implement the different types of curves for deviating type of alignments.

17CVL47-Fluid Mechanics and Hydraulic Machines Laboratory

**Course Objectives:** This course will enable students to;
1. calibrate flow measuring devices
2. determine the force exerted by jet of water on vanes
3. measure discharge and head losses in pipes
4. understand the fluid flow pattern

**Course outcomes:** During the course of study students will develop understanding of:
1. Properties of fluids and the use of various instruments for fluid flow measurement.
2. Working of hydraulic machines under various conditions of working and their characteristics.

17CVL48- Engineering Geology Laboratory

**Course objectives:**
1. To identify the minerals and rocks based on their inherent properties and uses in civil engineering
2. To interpret the geological maps related to civil engineering projects.
3. To learn the dip and strike, borehole problems, thickness of geological formation related to foundation, tunnels, reservoirs and mining.
4. To understand subsurface geological conditions through geophysical techniques and watershed management.
Course outcomes:
During this course, students will develop expertise in:
1. Identifying the minerals and rocks and utilize them effectively in civil engineering practices.
2. Understanding and interpreting the geological conditions of the area for the implementation of civil engineering projects.
3. Interpreting subsurface information such as thickness of soil, weathered zone, depth of hardrock and saturated zone by using geophysical methods.
4. The techniques of drawing the curves of electrical resistivity data and its interpretation for Geotechnical and aquifer boundaries.

5. To visit the civil engineering projects like dams, reservoirs, tunnels, quarries, etc.
17CV51-DESIGN OF RC STRUCTURAL ELEMENTS

Course objectives: This course will enable students to
1. Identify, formulate and solve engineering problems of RC elements subjected to
   different kinds of loading.
2. Follow a procedural knowledge in designing various structural RC elements.
3. Impart the culture of following the codes for strength, serviceability and
   durability as an ethics.
4. Provide knowledge in analysis and design of RC elements for the success in
   competitive examinations.

Course outcomes: After studying this course, students will be able to:
1. understand the design philosophy and principles
2. solve engineering problems of RC elements subjected to flexure, shear and torsion
3. demonstrate the procedural knowledge in designs of RC structural elements such
   as slabs, columns and footings
4. owns professional and ethical responsibility

17CV52-ANALYSIS OF INDETERMINATE STRUCTURES

Course Objectives: This course will enable students to
1. Apply knowledge of mathematics and engineering in calculating slope, deflection,
   bending moment and shear force using slope deflection, moment distribution
   method and Kani’s method.
2. Identify, formulate and solve problems in structural analysis.
3. Analyze structural system and interpret data.
4. use the techniques, such as stiffness and flexibility methods to solve engineering
   problems
5. communicate effectively in design of structural elements

Course outcomes: After studying this course, students will be able to:
1. Determine the moment in indeterminate beams and frames having variable
   moment of inertia and subsidence using slope deflection method
2. Determine the moment in indeterminate beams and frames of no sway and sway
   using moment distribution method.
3. Construct the bending moment diagram for beams and frames by Kani’s method.
4. Construct the bending moment diagram for beams and frames using flexibility
method
5. Analyze the beams and indeterminate frames by system stiffness method.

**17CV53-APPLIED GEOTECHNICAL ENGINEERING**

**Course objectives:** This course will enable students to
1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of Civil Engineering. Also to become familiar with foundation engineering terminology and understand how the principles of Geotechnology are applied in the design of foundations
2. Learn introductory concepts of Geotechnical investigations required for civil engineering projects emphasizing in situ investigations
3. Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
4. Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria
5. Study about assessing stability of slopes and earth pressure on rigid retaining Structures

**Course outcomes:** On the completion of this course students are expected to attain the following outcomes;
1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects
2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
4. Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
5. Capable of estimating load carrying capacity of single and group of piles

**17CV54-COMPUTER AIDED BUILDING PLANNING AND DRAWING**

**Course Objectives:** Provide students with a basic understanding
1. Achieve skill sets to prepare computer aided engineering drawings
2. Understand the details of construction of different building elements.
3. Visualize the completed form of the building and the intricacies of construction based on the engineering drawings.
Course outcomes: After studying this course, students will be able to
1. Gain a broad understanding of planning and designing of buildings
2. Prepare, read and interpret the drawings in a professional set up.
3. Know the procedures of submission of drawings and Develop working and submission drawings for building
4. Plan and design a residential or public building as per the given requirements

17CV551-AIR POLLUTION AND CONTROL

Course Objectives: This course will enable students to
1. Study the sources and effects of air pollution
2. Learn the meteorological factors influencing air pollution.
3. Analyze air pollutant dispersion models
4. Illustrate particular and gaseous pollution control methods

Course outcomes: After studying this course, students will be able to:
1. Identify the major sources of air pollution and understand their effects on health and environment.
2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
4. Choose and design control techniques for particulate and gaseous emissions

17 CV552-RAILWAYS, HARBOUR, TUNNELING AND AIRPORTS

Course Objectives: This course will enable students to
1. Understand the history and development, role of railways, railway planning and development based on essential criteria’s.
2. Learn different types of structural components, engineering properties of the materials, to calculate the material quantities required for construction
3. Understand various aspects of geometric elements, points and crossings, significance of maintenance of tracks.
4. Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids
5. Apply design features of tunnels, harbours, dock and necessary navigational aids; also expose them to various methods of tunneling and tunnel accessories.

Course outcomes: After studying this course, students will be able to:
1. Acquires capability of choosing alignment and also design geometric aspects of railway system, runway and taxiway.
2. 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.
3. 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.
4. Apply the knowledge gained to conduct surveying, understand the tunneling activities.

**17 CV561-TAFFIC ENGINEERING**

**Course Objectives:** This course will enable students to
1. Understand fundamental knowledge of traffic engineering, scope and its importance.
2. Describe basic techniques for collecting and analysing traffic data, diagnosing problems, designing appropriate remedial treatment, and assessing its effectiveness.
3. Apply probabilistic and queuing theory techniques for the analysis of traffic flow situations and emphasis the interaction of flow efficiency and traffic safety.
4. Understand and analyse traffic issues including safety, planning, design, operation and control.
5. Apply intelligent transport system and its applications in the present traffic scenario.

**Course outcomes:** After studying this course, students will be able to:
1. Understand the human factors and vehicular factors in traffic engineering design.
2. Conduct different types of traffic surveys and analysis of collected data using statistical concepts.
3. Use an appropriate traffic flow theory and to comprehend the capacity & signalized intersection analysis.
4. Understand the basic knowledge of Intelligent Transportation System.

**17CV563-REMOTE SENSING AND GIS**

**Course Objectives:** This course will enable students to
1. Understand the basic concepts of remote sensing.
2. Analyze satellite imagery and extract the required units.
3. Extract the GIS data and prepare the thematic maps.
4. Use the thematic maps for various applications.

**Course outcomes:** After studying this course, students will be able to:
1. Collect data and delineate various elements from the satellite imagery using their
spectral signature.
2. Analyze different features of ground information to create raster or vector data.
3. Perform digital classification and create different thematic maps for solving specific problems
4. Make decision based on the GIS analysis on thematic maps

**17CVL57-GEOTECHNICAL ENGINEERING LAB**

**Course Objectives:** This course will enable students to;
1. To carry out laboratory tests and to identify soil as per IS codal procedures
2. To perform laboratory tests to determine index properties of soil
3. To perform tests to determine shear strength and consolidation characteristics of Soils

**Course outcomes:** Students will be able to conduct appropriate laboratory/field experiments and interpret the results to determine
1. Physical and index properties of the soil
2. Classify based on index properties and field identification
3. To determine OMC and MDD, plan and assess field compaction program
4. Shear strength and consolidation parameters to assess strength and deformation characteristics
5. In-situ shear strength characteristics (SPT- Demonstration)

**17CVL58-CONCRETE AND HIGHWAY MATERIALS LABORATORY**

**Course objectives:** This course will enable students
1. To learn the principles and procedures of testing Concrete and Highway materials and to get hands on experience by conducting the tests and evolving inferences

**Course outcomes:** During this course, students will develop expertise in;
1. Conduct appropriate laboratory experiments and interpret the results
2. Determine the quality and suitability of cement
3. Design appropriate concrete mix
4. Determine strength and quality of concrete
5. Test the road aggregates and bitumen for their suitability as road material.
6. Test the soil for its suitability as sub grade soil for pavements.
17CV61-CONSTRUCTION MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives: This course will enable students to
1. Understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.
2. Inculcate Human values to grow as responsible human beings with proper personality.
3. Keep up ethical conduct and discharge professional duties.

Course Outcomes: After studying this course, students will be able to:
1. Understand the construction management process.
2. Understand and solve variety of issues that are encountered by every professional in discharging professional duties.
3. Fulfill the professional obligations effectively with global outlook.

17CV62-DESIGN OF STEEL STRUCTURAL ELEMENTS

Course Objectives: This course will enable students to
1. Understand advantages and disadvantages of steel structures, steel code provisions, and plastic behaviour of structural steel.
2. Learn Bolted connections and welded connections.
3. Design of compression members, built-up columns and columns splices.
4. Design of tension members, simple slab base and gusseted base.
5. Design of laterally supported and un-supported steel beams.

Course Outcomes: After studying this course, students will be able to:
1. Possess a knowledge of Steel Structures Advantages and Disadvantages of Steel structures, steel code provisions and plastic behaviour of structural steel.
2. Understand the Concept of Bolted and Welded connections.
3. Understand the Concept of Design of compression members, built-up columns and columns splices.
4. Understand the Concept of Design of tension members, simple slab base and gusseted base.
5. Understand the Concept of Design of laterally supported and un-supported steel beams.

17CV63-HIGHWAY ENGINEERING
**Course objectives:** This course will enable students to:
1. Gain knowledge of different modes of transportation systems, history, development of highways and the organizations associated with research and development of the same in INDIA.
2. Understand Highway planning and development considering the essential criteria’s (engineering and financial aspects, regulations and policies, socio economic impact).
3. Get insight to different aspects of geometric elements and train them to design geometric elements of a highway network.
4. Understand pavement and its components, pavement construction activities and its requirements.
5. Gain the skills of evaluating the highway economics by B/C, NPV, IRR methods and also introduce the students to highway financing concepts.

**Course outcomes:** After studying this course, students will be able to:
1. Acquire the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data.
2. Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction.
3. Design road geometrics, structural components of pavement and drainage.
4. Evaluate the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts.

17CV64-WATER SUPPLY AND TREATMENT ENGINEERING

**Course objectives:** This course will enable students to
1. Analyze the variation of water demand and to estimate water requirement for a community.
2. Evaluate the sources and conveyance systems for raw and treated water.
3. Study drinking water quality standards and to illustrate qualitative analysis of water.
4. Design physical, chemical and biological treatment methods to ensure safe and potable water Supply.

**Course Outcomes:** After studying this course, students will be able to:
1. Estimate average and peak water demand for a community.
2. Evaluate available sources of water, quantitatively and qualitatively and make appropriate choice for a community.
3. Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
4. Design a comprehensive water treatment and distribution system to purify and distribute water to the required quality standards.
17CV651-SOLID WASTE MANAGEMENT

Course objectives: This course will enable students to
1. Study the present methods of solid waste management system and to analyze their draw backs comparing with statutory rules.
2. Understand different elements of solid waste management from generation of solid waste to disposal.
3. Analyze different processing technologies and to study conversion of municipal solid waste to compost or biogas.
4. Evaluate landfill site and to study the sanitary landfill reactions.

Course outcomes: After studying this course, students will be able to:
1. Analyse existing solid waste management system and to identify their drawbacks.
2. Evaluate different elements of solid waste management system.
4. Design suitable processing system and evaluate disposal sites.

17CV661-WATER RESOURCES MANAGEMENT

Course objectives: This course will enable students to;
1. Judge surface and ground water resources.
2. Address the issues of water resources management.
3. Learn the principles of integrated water resources management.
4. Understand the legal framework of water policy.
5. Know the different methods of water harvesting

Course outcomes: After studying this course, students will be able to:
1. Assess the potential of groundwater and surface water resources.
2. Address the issues related to planning and management of water resources.
3. Know how to implement IWRM in different regions.
4. Understand the legal issues of water policy.
5. Select the method for water harvesting based on the area.

17CVL67-SOFTWARE APPLICATION LAB

Course objectives: This course will enable students to
1. Use industry standard software in a professional set up.
2. understand the elements of finite element modeling, specification of loads and boundary condition, performing analysis and interpretation of results for final design
3. Develop customized automation tools
**Course Outcomes:** After studying this course, students will be able to:
use software skills in a professional set up to automate the work and thereby reduce
cycle time for completion of the work

**17CVL68-EXTENSIVE SURVEY PROJECT /CAMP**

**Course objectives:** This course will enable students to
1. Understand the practical applications of Surveying.
2. Use Total station and other Measurement Equipments.
3. Work in teams and learn time management, communication and presentation
   Skills

**Course outcomes:** After studying this course, students will be able to:
1. Apply Surveying knowledge and tools effectively for the projects
2. Understanding Task environment, Goals, responsibilities, Task focus, working in
   Teams towards common goals, Organizational performance expectations,
   technical and behavioral competencies.
3. Application of individual effectiveness skills in team and organizational context,
   goal setting, time management, communication and presentation skills.
4. Professional etiquettes at workplace, meeting and general
5. Establishing trust based relationships in teams & organizational environment
6. Orientation towards conflicts in team and organizational environment,
   Understanding sources of conflicts, Conflict resolution styles and techniques
17CV71-MUNICIPAL AND INDUSTRIAL WASTE WATER ENGINEERING

**Course objectives:** This course will enable students to;
4. Understand sewerage network and influencing parameters.
5. Understand and design different unit operations involved in conventional and biological treatment process.
6. Apply the principles of Industrial effluent treatment process for different industrial wastes.
7. Evaluate self purification of streams depending on hydraulic and organic loading of sewage into receiving waters.

**Course outcomes:** After studying this course, students will be able to:
4. Acquires capability to design sewer and Sewerage treatment plant.
5. Evaluate degree of treatment and type of treatment for disposal, reuse and recycle.
6. Identify waste streams and design the industrial waste water treatment plant.
7. Manage sewage and industrial effluent issues.

17CV 72-DESIGN OF RCC AND STEEL STRUCTURES

**Course objectives:** This course will enable students to
6. Provide basic knowledge in the areas of limit state method and concept of design of RC and Steel structures
7. Identify, formulate and solve engineering problems in RC and Steel Structures
8. Give procedural knowledge to design a system, component or process as per needs and specifications of RC Structures like Retaining wall, Footing, Water tanks, Portal Frames and Steel Structures like Roof Truss, Plate Girder and Gantry Girder.
9. Imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design of RC and Steel Structures.
10. Provide factual knowledge on analysis and design of RC Structural elements, who can participate and succeed in competitive examinations.

**Course Outcomes:** After studying this course, students will be able to:
6. Students will acquire the basic knowledge in design of RCC and Steel Structures.
7. Students will have the ability to follow design procedures as per codal provisions and skills to arrive at structurally safe RC and Steel members.

17CV73-HYDROLOGY AND IRRIGATION ENGINEERING

**Course Objectives:** This course will enable students to;
1. Understand the concept of hydrology and components of hydrologic cycle such as precipitation, infiltration, evaporation and transpiration.
2. Quantify runoff and use concept of unit hydrograph.
3. Demonstrate different methods of irrigation, methods of application of water and irrigation procedure.
4. Design canals and canal network based on the water requirement of various crops.
5. Determine the reservoir capacity.

**Course outcomes:** After studying this course, students will be able to:
1. Understand the importance of hydrology and its components.
2. Measure precipitation and analyze the data and analyze the losses in precipitation.
3. Estimate runoff and develop unit hydrographs.
4. Find the benefits and ill-effects of irrigation.
5. Find the quantity of irrigation water and frequency of irrigation for various crops.
6. Find the canal capacity, design the canal and compute the reservoir capacity.

**17CV741-DESIGN OF BRIDGES**

**Course objectives:** This course will enable students to understand the analysis and design of concrete Bridges.

**Course outcomes:** After studying this course, students will be able to:
- Understand the load distribution and IRC standards.
- Design the slab and T beam bridges.
- Design Box culvert, pipe culvert
- Use bearings, hinges and expansion joints and
- Design Piers and abutments.

**17CV742-GROUND WATER & HYDRAULICS**

**Course objectives:** This course will enable students
- To characterize the properties of ground water and aquifers.
- To quantify the ground water flow.
- To locate occurrence of ground water and augment ground water resources.
- To synthesize ground water development methods.

**Course outcomes:** After studying this course, students will be able to:
- Find the characteristics of aquifers.
- Estimate the quantity of ground water by various methods.
- Locate the zones of ground water resources.
- Select particular type of well and augment the ground water storage.
\textbf{17CV743-DESIGN CONCEPT OF BUILDING SERVICES}

\textbf{Course Objectives:} This course will enable students to:
1. learn the importance of sanitation, domestic water supply, plumbing and fire services
2. Understand the concepts of heat, ventilation and air conditioning
3. Develop technical and practical knowledge in Building Services.

\textbf{Course Outcomes:} After studying this course, students will be able to:
1. Describe the basics of house plumbing and waste water collection and disposal.
2. Discuss the safety and guidelines with respect to fire safety.
3. Describe the issues with respect to quantity of water, rain water harvesting and roof top harvesting.
4. Understand and implement the requirements of thermal comfort in buildings

\textbf{17CV751-URBAN TRANSPORTATION AND PLANNING}

\textbf{Course Objectives:} This course will enable students to:
1. Understand and apply basic concepts and methods of urban transportation planning.
2. Apprise about the methods of designing, conducting and administering surveys to provide the data required for transportation planning.
3. Understand the process of developing an organized mathematical modelling approach to solve select urban transportation planning problem.
4. Excel in use of various types of models used for travel forecasting, prediction of future travel patterns.

\textbf{Course outcomes:} After studying this course, students will be able to:
1. Design, conduct and administer surveys to provide the data required for transportation planning.
2. Supervise the process of data collection about travel behavior and analyze the data for use in transport planning.
3. Develop and calibrate modal split, trip generation rates for specific types of land use developments.
4. Adopt the steps that are necessary to complete a long-term transportation plan

\textbf{17CV753-REHABILITATION AND RETROFITTING OF STRUCTURES}

\textbf{Course Objectives:} This course will enable students to:
\begin{itemize}
\item Investigate the cause of deterioration of concrete structures.
\item Strategise different repair and rehabilitation of structures.
\end{itemize}
· Evaluate the performance of the materials for repair

**Course outcomes:** After studying this course, students will be able to:
1. Understand the cause of deterioration of concrete structures.
2. Able to assess the damage for different type of structures
3. Summarize the principles of repair and rehabilitation of structures
4. Recognize ideal material for different repair and retrofitting technique

**17CVL76-ENVIRONMENTAL ENGINEERING LABORATORY**

**Course objectives:** This course will enable students,
1. To learn different methods of water & waste water quality
2. To conduct experiments to determine the concentrations of water and waste water
3. To determine the degree and type of treatment
4. To understand the environmental significance and application in environmental engineering practice

**Course Outcomes:** After studying this course, students will be able to:
1. Acquire capability to conduct experiments and estimate the concentration of different parameters.
2. Compare the result with standards and discuss based on the purpose of analysis.
3. Determine type of treatment, degree of treatment for water and waste water.
4. Identify the parameter to be analyzed for the student project work in environmental stream.

**17CVL77-COMPUTER AIDED DETAILING OF STRUCTURES**

**Course objectives:** This course will enable students to
· Be aware of the Scale Factors, Sections of drawings,
· Draft the detailing of RC and Steel Structural member.

**Course outcomes:** After studying this course, students will be able to:
4. Prepare detailed working drawings

**Program Objectives:**
· Engineering knowledge
· Problem analysis
· Interpretation of data
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Name</th>
<th>Subject Code</th>
<th>COs</th>
</tr>
</thead>
</table>
| 1.     | Management and Entrepreneurship Development | 17ES51 | 1. Understand the fundamental concepts of Management and Entrepreneurship  
2. Select a best Entrepreneurship model for the required domain of establishment  
3. Describe the functions of Managers, Entrepreneurs and their social responsibilities  
4. Compare various types of Entrepreneurs  
5. Analyze the Institutional support by various state and central government agencies |
<p>| 2.     | Digital Signal                     | 17EC52 | 1. Determine response of LTI systems using time domain and DFT techniques. |</p>
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject Name</th>
<th>Subject Code</th>
<th>COs</th>
</tr>
</thead>
</table>
| 1.     | Digital Communication                 | 17EC61       | 1. Associate and apply the concepts of Band pass sampling to well specified signals and channels.  
2. Analyze and compute performance parameters and transfer rates for low pass and band pass symbol under ideal and corrupted non band limited channels.  
3. Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted band limited channels. |
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<thead>
<tr>
<th>Sl. No.</th>
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<th>COs</th>
</tr>
</thead>
</table>
| 1      | Microwave and Antennas                   | 17EC71       | 1. Describe the use and advantages of microwave transmission  
2. Analyze various parameters related to microwave transmission lines and waveguides  
3. Identify microwave devices for several applications  
4. Analyze various antenna parameters necessary for building an RF system |
| 2      | ARM Microcontroller & Embedded Systems   | 17EC62       | 1. Describe the architectural features and instructions of 32 bit microcontroller ARM Cortex M3.  
2. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.  
3. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.  
4. Develop the hardware/software co-design and firmware design approaches.  
5. Explain the need of real time operating system for embedded system applications. |
| 3      | VLSI Design                              | 17EC63       | 1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.  
2. Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.  
3. Interpret Memory elements along with timing considerations  
4. Demonstrate knowledge of FPGA based system design  
5. Interpret testing and testability issues in VLSI Design  
6. Analyze CMOS subsystems and architectural issues with the design constraints. |
| 4      | Computer Communication Networks          | 17EC64       | 1. Identify the protocols and services of Data link layer.  
2. Identify the protocols and functions associated with the transport layer services.  
3. Describe the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.  
4. Distinguish the basic network configurations and standards associated with each network.  
5. Construct a network model and determine the routing of packets using different routing algorithms. |
| 5      | Professional Elective-2(Digital Switching Systems) | 17EC654     | 1. Describe the electromechanical switching systems and its comparison with the digital switching.  
2. Determine the telecommunication traffic and its measurements.  
3. Define the technologies associated with the data switching operations.  
4. Describe the software aspects of switching systems and its maintenance. |
| 6      | Open Elective-2(Digital System Design using Verilog) | 17EC663     | 1. Construct the combinational circuits, using discrete gates and programmable logic devices.  
2. Describe Verilog model for sequential circuits and test pattern generation.  
3. Design a semiconductor memory for specific chip design.  
4. Design embedded systems using small microcontrollers, larger CPUs/DSPs, or hard or soft processor cores.  
5. Synthesize different types of processor and I/O controllers that are used in embedded system. |
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Wireless Cellular and LTE 4G Broadband</td>
<td>17EC81</td>
<td>1. Understand the system architecture and the functional standard specified in LTE 4G.</td>
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<td>2. Analyze the role of LTE radio interface protocols and EPS Data convergence protocols to set up, reconfigure and release data and voice from users.</td>
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</tbody>
</table>

**Course Outcomes for 2017-18**
<p>| | | |</p>
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<tbody>
<tr>
<td>2.</td>
<td><strong>Fiber Optics &amp; Networks</strong></td>
<td>17EC82</td>
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<tr>
<td></td>
<td>1. Classification and working of optical fiber with different modes of signal propagation.</td>
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<td>2. Describe the transmission characteristics and losses in optical fiber communication.</td>
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<td>3. Describe the construction and working principle of optical connectors, multiplexers and amplifiers.</td>
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<td>4. Describe the constructional features and the characteristics of optical sources and detectors.</td>
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<td>5. Illustrate the networking aspects of optical fiber and describe various standards associated with it.</td>
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<tr>
<td>3.</td>
<td><strong>Professional Elective-5 (Machine learning)</strong></td>
<td>17EC834</td>
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<tr>
<td></td>
<td>1. Understand the core concepts of Machine learning.</td>
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<td>2. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms.</td>
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<td></td>
<td>4. Recognize a real world problem and apply the learned techniques of Machine Learning to solve the problem.</td>
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<tr>
<td>Sl.No</td>
<td>Course name and code</td>
<td>Course outcomes</td>
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</tr>
<tr>
<td>1</td>
<td>Engineering Mathematics – III (15MAT31)</td>
<td>MAT31.1 Know the use of periodic signals and Fourier series to analyze circuits and system communications. &lt;br&gt; MAT31.2 Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform. &lt;br&gt; MAT31.3 Employ appropriate numerical methods to solve algebraic and transcendental equations. &lt;br&gt; MAT31.4 Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems. &lt;br&gt; MAT31.5 Determine the extremals of functionals and solve the simple problems of the calculus of variations.</td>
</tr>
<tr>
<td>2</td>
<td>ANALOG AND DIGITAL ELECTRONICS (15CS32)</td>
<td>CS32.1 Explain the operation of JFETs and MOSFETs, Operational Amplifier circuits and their application &lt;br&gt; CS32.2 Explain Combinational Logic, Simplification Techniques using Karnaugh Maps, Quine McClusky technique. &lt;br&gt; CS32.3 Demonstrate Operation of Decoders, Encoders, Multiplexers, Adders and Subtractors, working of Latches, Flip-Flops, Designing Registers, Counters, A/D and D/A Converters &lt;br&gt; CS32.4 Design of Counters, Registers and A/D &amp; D/A converters</td>
</tr>
<tr>
<td>3</td>
<td>DATA STRUCTURES AND APPLICATIONS (15CS33)</td>
<td>CS33.1 Explain different types of data structures, operations and algorithms &lt;br&gt; CS33.2 Apply searching and sorting operations on files &lt;br&gt; CS33.3 Make use of stack, Queue, Lists, Trees and Graphs in problem solving. &lt;br&gt; CS33.4 Develop all data structures in a high-level language for problem solving.</td>
</tr>
<tr>
<td>4</td>
<td>COMPUTER ORGANIZATION (15CS34)</td>
<td>CS34.1 Explain the basic organization of a computer system. &lt;br&gt; CS34.2 Demonstrate functioning of different sub systems, such as processor, Input/output, and memory. &lt;br&gt; CS34.3 Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems. &lt;br&gt; CS34.4 Build simple arithmetic and logical units.</td>
</tr>
</tbody>
</table>
|   | UNIX AND SHELL PROGRAMMING (15CS35) | CS35.1 Explain UNIX system and use different commands.  
CS35.2 Compile Shell scripts for certain functions on different subsystems.  
CS35.3 Demonstrate use of editors and Perl script writing |
|---|---|---|
| 6 | DISCRETE MATHEMATICAL STRUCTURES (15CS36) | CS36.1 Make use of propositional and predicate logic in knowledge representation and truth verification.  
CS36.2 Demonstrate the application of discrete structures in different fields of computer science.  
CS36.3 Solve problems using recurrence relations and generating functions.  
CS36.4 Apply different mathematical proofs, techniques in proving theorems.  
CS36.5 Compare graphs, trees and their applications. |
| 7 | ADDITIONAL MATHEMATICS – I (15MATDIP31) | MATDIP31.1 Understand the fundamental concepts of complex numbers and vector algebra to analyze the problems arising in related area.  
MATDIP31.2 Use derivatives and partial derivatives to calculate rates of change of multivariate functions.  
MATDIP31.3 Learn techniques of integration including double and triple integrals to find area, volume, mass and moment of inertia of plane and solid region.  
MATDIP31.4 Analyze position, velocity and acceleration in two or three dimensions using the calculus of vector valued functions.  
MATDIP31.5 Recognize and solve first-order ordinary differential equations occurring in different branches of engineering. |
| 9 | ENGINEERING MATHEMATICS-IV (15CS41) | CS41.1 Solve first and second order ordinary differential equation arising in flow problems using single step and multistep numerical methods.  
CS41.2 Illustrate problems of potential theory, quantum mechanics and heat conduction by employing notions and properties of Bessel’s functions and Legendre’s polynomials.  
CS41.3 Explain the concepts of analytic functions, residues, poles of complex potentials and describe conformal and Bilinear transformation arising in field theory and signal processing.  
CS41.4 Develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, information theory and design engineering.  
CS41.5 Demonstrate testing of hypothesis of sampling distributions and illustrate examples of Markov chains |
| 10 | SOFTWARE ENGINEERING  
(15CS42) | **CS42.1** Design a software system, component, or process to meet desired needs within realistic constraints.  
**CS42.2** Assess professional and ethical responsibility  
**CS42.2** Function on multi-disciplinary teams  
**CS42.3** Make use of techniques, skills, and modern engineering tools necessary for engineering practice  
**CS42.4** Comprehend software systems or parts of software systems. |
| 11 | DESIGN AND ANALYSIS OF ALGORITHMS (15CS43) | **CS43.1** Describe computational solution to well known problems like searching, sorting etc.  
**CS43.2** Estimate the computational complexity of different algorithms.  
**CS43.3** Develop an algorithm using appropriate design strategies for problem solving. |
| 12 | MICROPROCESSORS AND MICROCONTROLLERS  
(15CS44) | **CS44.1** Differentiate between microprocessors and microcontrollers  
**CS44.2** Develop assembly language code to solve problems  
**CS44.3** Explain interfacing of various devices to x86 family and ARM processor  
**CS44.4** Demonstrate interrupt routines for interfacing devices |
| 13 | OBJECT ORIENTED CONCEPTS  
(15CS45) | **CS45.1** Explain the object-oriented concepts and JAVA.  
**CS45.2** Develop computer programs to solve real world problems in Java.  
**CS45.3** Develop simple GUI interfaces for a computer program to interact with users, and to comprehend the event-based GUI handling principles using Applets and swings. |
| 14 | DATA COMMUNICATION  
(15CS46) | **CS46.1** Illustrate basic computer network technology.  
**CS46.2** Identify the different types of network topologies and protocols.  
**CS46.3** List and explain the layers of the OSI model and TCP/IP model.  
**CS46.4** Comprehend the different types of network devices and their functions within a network  
**CS46.5** Demonstrate subnetting and routing mechanisms |
| 15 | ADDITIONAL MATHEMATICS – II  
(15MATDIP41) | **MATDIP41.1** Solve systems of linear equations in the different areas of linear algebra.  
**MATDIP41.2** Solve second and higher order differential equations occurring in of electrical circuits, damped/undamped vibrations.  
**MATDIP41.3** Describe Laplace transforms of standard |
and periodic functions.
**MATDIP41.4** Determine the general/complete solutions to linear ODE using inverse Laplace transforms.
**MATDIP41.5** Recall basic concepts of elementary probability theory and, solve problems related to the decision theory, synthesis and optimization of digital circuits.

| 16 | MANAGEMENT AND ENTREPRENEURSHIP FOR IT INDUSTRY (15CS51) | CS51.1 Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship  
CS51.2 Utilize the resources available effectively through ERP  
CS51.3 Make use of IPRs and institutional support in entrepreneurship |
| 17 | COMPUTER NETWORKS (15CS52) | CS52.1 Explain principles of application layer protocols  
CS52.2 Outline transport layer services and infer UDP and TCP protocols  
CS52.3 Classify routers, IP and Routing Algorithms in network layer  
CS52.4 Explain the Wireless and Mobile Networks covering IEEE 802.11 Standard  
CS52.5 Define Multimedia Networking and Network Management |
| 18 | DATABASE MANAGEMENT SYSTEM (15CS53) | CS53.1 Summarize the concepts of database objects; enforce integrity constraints on a database using RDBMS.  
CS53.2 Use Structured Query Language (SQL) for database manipulation.  
CS53.3 Design simple database systems  
CS53.4 Design code for some application to interact with databases. |
| 19 | AUTOMATA THEORY AND COMPUTABILITY (15CS54) | CS54.1 Tell the core concepts in automata theory and Theory of Computation  
CS54.2 Explain how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).  
CS54.3 Interpret Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation |
<table>
<thead>
<tr>
<th></th>
<th>Regular, Context Free) and their relative powers. CS54.4 Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness. CS54.5 Classify a problem with respect to different models of Computation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>INTRODUCTION TO SOFTWARE TESTING (15CS552)</td>
</tr>
<tr>
<td></td>
<td>CS552.1 Identify test cases for any given problem. CS552.2 Compare the different testing techniques. CS552.3 Classify the problems according to a suitable testing model. CS552.4 Apply the appropriate technique for the design of flow graphs. CS552.5 Create appropriate document for the software artefact.</td>
</tr>
<tr>
<td>21</td>
<td>ADVANCED JAVA AND J2EE (15CS553)</td>
</tr>
<tr>
<td></td>
<td>CS553.1 Interpret the need for advanced Java concepts like enumerations and collections in developing modular and efficient programs CS553.2 Build client-server applications and TCP/IP socket programs CS553.3 Illustrate database access and details for managing information using the JDBC API CS553.4 Describe how servlets fit into Java-based web application architecture CS553.5 Develop reusable software components using Java Beans</td>
</tr>
<tr>
<td>22</td>
<td>ARTIFICIAL INTELLIGENCE (15CS562)</td>
</tr>
<tr>
<td></td>
<td>CS562.1 Identify the AI based problems CS562.2 Apply techniques to solve the AI problems CS562.3 Define learning and explain various learning techniques CS562.4 Discuss expert systems</td>
</tr>
<tr>
<td>23</td>
<td>DOT NET FRAMEWORK FOR APPLICATION DEVELOPMENT (15CS564)</td>
</tr>
</tbody>
</table>
|   | CS564.1 Build applications on Visual Studio .NET platform by understanding the syntax and semantics of C# CS564.2 Demonstrate Object Oriented Programming concepts in C# programming language CS564.3 Design custom interfaces for applications and leverage the available built-in interfaces in building complex applications. CS564.4 Illustrate the use of generics and collections in
<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>CRYPTOGRAPHY, NETWORK SECURITY AND CYBER LAW (15CS61)</td>
</tr>
<tr>
<td>25</td>
<td>COMPUTER GRAPHICS AND VISUALIZATION (15CS62)</td>
</tr>
<tr>
<td>26</td>
<td>SYSTEM SOFTWARE AND COMPILER DESIGN (15CS63)</td>
</tr>
<tr>
<td>27</td>
<td>OPERATING SYSTEMS (15CS64)</td>
</tr>
<tr>
<td>28</td>
<td>DATA MINING AND DATA WAREHOUSING (15CS651)</td>
</tr>
</tbody>
</table>

**CS564.5** Compose queries to query in-memory data and define own operator behaviour

**CS61.1** Discuss the cryptography and its need to various applications  
**CS61.2** Design and Develop simple cryptography algorithms  
**CS61.3** Understand the cyber security and need cyber Law

**CS62.1** Design and implement algorithms for 2D graphics primitives and attributes.  
**CS62.2** Illustrate Geometric transformations on both 2D and 3D objects.  
**CS62.3** Understand the concepts of clipping and visible surface detection in 2D and 3D viewing, and Illumination Models.  
**CS62.4** Discuss about suitable hardware and software for developing graphics packages using OpenGL.

**CS63.1** Illustrate system software such as assemblers, loaders, linkers and microprocessors  
**CS63.2** Design and develop lexical analysers, parsers and code generators  
**CS63.3** Discuss about lex and yacc tools for implementing different concepts of system software

**CS64.1** Demonstrate need for OS and different types of OS  
**CS64.2** Discuss suitable techniques for management of different resources  
**CS64.3** Illustrate processor, memory, storage and file system commands  
**CS64.4** Explain the different concepts of OS in platform of usage through case studies

**CS651.1** Understand data mining problems and implement the data warehouse  
**CS651.2** Demonstrate association rules for a given data pattern.  
**CS651.3** Discuss between classification and clustering solution.
| 29 | OPERATIONS RESEARCH (15CS653) | CS653.1 Explain optimization techniques for various problems.  
     |                             | CS653.2 Understand the given problem as transportation and assignment problem and solve.  
     |                             | CS653.3 Illustrate game theory for decision support system. |
| 30 | PYTHON APPLICATION PROGRAMMING (15CS664) | CS664.1 Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.  
     |                             | CS664.2 Demonstrate proficiency in handling Strings and File Systems.  
     |                             | CS664.3 Implement Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.  
     |                             | CS664.4 Interpret the concepts of Object-Oriented Programming as used in Python.  
     |                             | CS664.5 Implement exemplary applications related to Network Programming, Web Services and Databases in Python. |
| 31 | WEB TECHNOLOGY AND ITS APPLICATIONS (15CS71) | CS71.1 Adapt HTML and CSS syntax and semantics to build web pages.  
     |                             | CS71.2 Construct and visually format tables and forms using HTML and CSS  
     |                             | CS71.3 Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.  
     |                             | CS71.4 Appraise the principles of object oriented development using PHP  
     |                             | CS71.5 Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features. |
| 32 | ADVANCED COMPUTER ARCHITECTURES (15CS72) | CS72.1 Explain the concepts of parallel computing and hardware technologies  
     |                             | CS72.2 Compare and contrast the parallel architectures  
     |                             | CS72.3 Illustrate parallel programming concepts |
| 33 | MACHINE LEARNING (15CS73) | CS73.1 Identify the problems for machine learning. And select the either supervised, unsupervised or reinforcement learning.  
<pre><code> |                             | CS73.2 Explain theory of probability and statistics related to machine learning |
</code></pre>
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Topics</th>
</tr>
</thead>
</table>
| 34 | CLOUD COMPUTING AND ITS APPLICATIONS (15CS742) | CS742.1 Explain cloud computing, virtualization and classify services of cloud computing  
CS742.2 Illustrate architecture and programming in cloud  
CS742.3 Describe the platforms for development of cloud applications and List the application of cloud. |
| 35 | INFORMATION AND NETWORK SECURITY (15CS743) | CS743.1 Analyze the Digital security lapses  
CS743.2 Illustrate the need of key management  
CS743.3 Indicate the location of a security process in the given system |
| 36 | STORAGE AREA NETWORKS (15CS754) | CS754.1 Identify key challenges in managing information and analyze different storage networking technologies and virtualization  
CS754.2 Explain components and the implementation of NAS  
CS754.3 Describe CAS architecture and types of archives and forms of virtualization  
CS754.4 Illustrate the storage infrastructure and management activities |
| 37 | INTERNET OF THINGS TECHNOLOGY (15CS81) | CS81.1 Interpret the impact and challenges posed by IoT networks leading to new architectural models.  
CS81.2 Compare and contrast the deployment of smart objects and the technologies to connect them to network.  
CS81.3 Appraise the role of IoT protocols for efficient network communication.  
CS81.4 Elaborate the need for Data Analytics and Security in IoT.  
CS81.5 Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry. |
| 38 | BIG DATA ANALYTICS (15CS82) | CS82.1 Master the concepts of HDFS and MapReduce framework  
CS82.2 Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop Administration  
CS82.3 Recognize the role of Business Intelligence, Data warehousing and Visualization in decision making  
CS82.4 Infer the importance of core data mining |
| 39 | SYSTEM MODELLING AND SIMULATION (15CS834) | techniques for data analytics  
CS82.5 Compare and contrast different Text Mining Techniques  
CS834.1 Explain the system concept and apply functional modeling method to model the activities of a static system  
CS834.2 Describe the behavior of a dynamic system and create an analogous model for a dynamic system;  
CS834.3 Simulate the operation of a dynamic system and make improvement according to the simulation results. |
<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Course name and code</th>
<th>Course outcomes</th>
</tr>
</thead>
</table>
| 1     | Engineering Mathematics – III(15MAT31)| **MAT31.1** Know the use of periodic signals and Fourier series to analyze circuits and system communications.  
**MAT31.2** Explain the general linear system theory for continuous-time signals and digital signal processing using the Fourier Transform and z-transform.  
**MAT31.3** Employ appropriate numerical methods to solve algebraic and transcendental equations.  
**MAT31.4** Apply Green's Theorem, Divergence Theorem and Stokes' theorem in various applications in the field of electro-magnetic and gravitational fields and fluid flow problems.  
**MAT31.5** Determine the extremals of functionals and solve the simple problems of the calculus of variations. |
| 2     | ANALOG AND DIGITAL ELECTRONICS(15CS32)| **CS32.1** Explain the operation of JFETs and MOSFETs, Operational Amplifier circuits and their application  
**CS32.2** Explain Combinational Logic, Simplification Techniques using Karnaugh Maps, Quine McClusky technique.  
**CS32.3** Demonstrate Operation of Decoders, Encoders, Multiplexers, Adders and Subtractors, working of Latches, Flip-Flops, Designing Registers, Counters, A/D and D/A Converters  
**CS32.4** Design of Counters, Registers and A/D & D/A converters |
| 3     | DATA STRUCTURES AND APPLICATIONS(15CS33)| **CS33.1** Explain different types of data structures, operations and algorithms  
**CS33.2** Apply searching and sorting operations on files  
**CS33.3** Make use of stack, Queue, Lists, Trees and Graphs in problem solving.  
**CS33.4** Develop all data structures in a high-level language for problem solving. |
| 4     | COMPUTER ORGANIZATION (15CS34)        | **CS34.1** Explain the basic organization of a computer system.  
**CS34.2** Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.  
**CS34.3** Illustrate hardwired control and micro programmed control, pipelining, embedded and other computing systems.  
**CS34.4** Build simple arithmetic and logical units. |
|   | UNIX AND SHELL PROGRAMMING (15CS35) | CS35.1 Explain UNIX system and use different commands.  
CS35.2 Compile Shell scripts for certain functions on different subsystems.  
CS35.3 Demonstrate use of editors and Perl script writing |
|---|-------------------------------------|-------------------------------------------------|
|   | DISCRETE MATHEMATICAL STRUCTURES (15CS36) | CS36.1 Make use of propositional and predicate logic in knowledge representation and truth verification.  
CS36.2 Demonstrate the application of discrete structures in different fields of computer science.  
CS36.3 Solve problems using recurrence relations and generating functions.  
CS36.4 Apply different mathematical proofs, techniques in proving theorems.  
CS36.5 Compare graphs, trees and their applications. |
|   | ADDITIONAL MATHEMATICS – I)15MATDIP31) | MATDIP31.1 Understand the fundamental concepts of complex numbers and vector algebra to analyze the problems arising in related area.  
MATDIP31.2 Use derivatives and partial derivatives to calculate rates of change of multivariate functions.  
MATDIP31.3 Learn techniques of integration including double and triple integrals to find area, volume, mass and moment of inertia of plane and solid region.  
MATDIP31.4 Analyze position, velocity and acceleration in two or three dimensions using the calculus of vector valued functions.  
MATDIP31.5 Recognize and solve first-order ordinary differential equations occurring in different branches of engineering. |
|   | ENGINEERING MATHEMATICS-IV (15CS41) | CS41.1 Solve first and second order ordinary differential equation arising in flow problems using single step and multistep numerical methods.  
CS41.2 Illustrate problems of potential theory, quantum mechanics and heat conduction by employing notions and properties of Bessel’s functions and Legendre’s polynomials.  
CS41.3 Explain the concepts of analytic functions, residues, poles of complex potentials and describe conformal and Bilinear transformation arising in field theory and signal processing.  
CS41.4 Develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, information theory and design engineering.  
CS41.5 Demonstrate testing of hypothesis of sampling distributions and illustrate examples of Markov chains |
| 10 | SOFTWARE ENGINEERING (15CS42) | 10.1 Design a software system, component, or process to meet desired needs within realistic constraints.  
10.2 Assess professional and ethical responsibility  
10.3 Function on multi-disciplinary teams  
10.4 Make use of techniques, skills, and modern engineering tools necessary for engineering practice  
10.5 Comprehend software systems or parts of software systems. |
| 11 | DESIGN AND ANALYSIS OF ALGORITHMS (15CS43) | 11.1 Describe computational solution to well known problems like searching, sorting etc.  
11.2 Estimate the computational complexity of different algorithms.  
11.3 Develop an algorithm using appropriate design strategies for problem solving. |
| 12 | MICROPROCESSORS AND MICROCONTROLLERS (15CS44) | 12.1 Differentiate between microprocessors and microcontrollers  
12.2 Develop assembly language code to solve problems  
12.3 Explain interfacing of various devices to x86 family and ARM processor  
12.4 Demonstrate interrupt routines for interfacing devices |
| 13 | OBJECT ORIENTED CONCEPTS (15CS45) | 13.1 Explain the object-oriented concepts and JAVA.  
13.2 Develop computer programs to solve real world problems in Java.  
13.3 Develop simple GUI interfaces for a computer program to interact with users, and to comprehend the event-based GUI handling principles using Applets and swings. |
| 14 | DATA COMMUNICATION (15CS46) | 14.1 Illustrate basic computer network technology.  
14.2 Identify the different types of network topologies and protocols.  
14.3 List and explain the layers of the OSI model and TCP/IP model.  
14.4 Comprehend the different types of network devices and their functions within a network  
14.5 Demonstrate subnetting and routing mechanisms |
| 15 | ADDITIONAL MATHEMATICS – II (15MATDIP41) | 15.1 Solve systems of linear equations in the different areas of linear algebra.  
15.2 Solve second and higher order differential equations occurring in electrical circuits, damped/undamped vibrations.  
15.3 Describe Laplace transforms of standard |
| Course Code | Course Title | Description
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<tr>
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<tbody>
<tr>
<td>MATDIP41.4</td>
<td>Determine the general/complete solutions to linear ODE using inverse Laplace transforms.</td>
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<tr>
<td>MATDIP41.5</td>
<td>Recall basic concepts of elementary probability theory and solve problems related to the decision theory, synthesis and optimization of digital circuits.</td>
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<tr>
<td>CS51.1</td>
<td>Define management, organization, entrepreneur, planning, staffing, ERP and outline their importance in entrepreneurship.</td>
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<tr>
<td>CS51.2</td>
<td>Utilize the resources available effectively through ERP.</td>
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<tr>
<td>CS51.3</td>
<td>Make use of IPRs and institutional support in entrepreneurship.</td>
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<tr>
<td>CS52.1</td>
<td>Explain principles of application layer protocols.</td>
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<tr>
<td>CS52.2</td>
<td>Outline transport layer services and infer UDP and TCP protocols.</td>
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<tr>
<td>CS52.3</td>
<td>Classify routers, IP and Routing Algorithms in network layer.</td>
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<tr>
<td>CS52.4</td>
<td>Explain the Wireless and Mobile Networks covering IEEE 802.11 Standard.</td>
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<tr>
<td>CS52.5</td>
<td>Define Multimedia Networking and Network Management.</td>
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<tr>
<td>CS53.1</td>
<td>Summarize the concepts of database objects; enforce integrity constraints on a database using RDBMS.</td>
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<tr>
<td>CS53.2</td>
<td>Use Structured Query Language (SQL) for database manipulation.</td>
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<tr>
<td>CS53.3</td>
<td>Design simple database systems.</td>
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<tr>
<td>CS53.4</td>
<td>Design code for some application to interact with databases.</td>
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<tr>
<td>CS54.1</td>
<td>Tell the core concepts in automata theory and Theory of Computation.</td>
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<tr>
<td>CS54.2</td>
<td>Explain how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).</td>
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<tr>
<td>CS54.3</td>
<td>Interpret Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation.</td>
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<tr>
<td>Week</td>
<td>Course</td>
<td>Syllabus</td>
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<tr>
<td>20</td>
<td>INTRODUCTION TO SOFTWARE TESTING (15CS552)</td>
<td>Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness. Classify a problem with respect to different models of Computation.</td>
</tr>
<tr>
<td>21</td>
<td>ADVANCED JAVA AND J2EE (15CS553)</td>
<td>Identify test cases for any given problem. Compare the different testing techniques. Classify the problems according to a suitable testing model. Apply the appropriate technique for the design of flow graphs. Create appropriate document for the software artefact.</td>
</tr>
<tr>
<td>22</td>
<td>ARTIFICIAL INTELLIGENCE (15CS562)</td>
<td>Interpret the need for advanced Java concepts like enumerations and collections in developing modular and efficient programs. Build client-server applications and TCP/IP socket programs. Illustrate database access and details for managing information using the JDBC API. Describe how servlets fit into Java-based web application architecture. Develop reusable software components using Java Beans.</td>
</tr>
<tr>
<td>23</td>
<td>DOT NET FRAMEWORK FOR APPLICATION DEVELOPMENT (15CS564)</td>
<td>Identify the AI based problems. Apply techniques to solve the AI problems. Define learning and explain various learning techniques. Discuss expert systems. Build applications on Visual Studio .NET platform by understanding the syntax and semantics of C#. Demonstrate Object Oriented Programming concepts in C# programming language. Design custom interfaces for applications and leverage the available built-in interfaces in building complex applications. Illustrate the use of generics and collections in</td>
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<tr>
<td>Module</td>
<td>Description</td>
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<tr>
<td>C#</td>
<td>CS564.5 Compose queries to query in-memory data and define own operator behaviour</td>
<td></td>
</tr>
</tbody>
</table>
| 24 CRYPTOGRAPHY, NETWORK SECURITY AND CYBER LAW (15CS61) | CS61.1 Discuss the cryptography and its need to various applications  
|                                          | CS61.2 Design and Develop simple cryptography algorithms  
|                                          | CS61.3 Understand the cyber security and need cyber Law |
| 25 FILE STRUCTURES (15IS62)              | IS62.1 Choose appropriate file structure for storage representation.  
|                                          | IS62.2 Identify a suitable sorting technique to arrange the data.  
|                                          | IS62.3 Select suitable indexing and hashing techniques for better performance to a given problem. |
| 26 SOFTWARE TESTING (15IS63)             | IS63.1 Derive test cases for any given problem  
|                                          | IS63.2 Compare the different testing techniques  
|                                          | IS63.3 Classify the problem into suitable testing model  
|                                          | IS63.4 Apply the appropriate technique for the design of flow graph.  
|                                          | IS63.5 Create appropriate document for the software artefact. |
| 27 OPERATING SYSTEMS (15CS64)            | CS64.1 Demonstrate need for OS and different types of OS  
|                                          | CS64.2 Discuss suitable techniques for management of different resources  
|                                          | CS64.3 Illustrate processor, memory, storage and file system commands  
|                                          | CS64.4 Explain the different concepts of OS in platform of usage through case studies |
| 28 DATA MINING AND DATA WAREHOUSING (15CS651) | CS651.1 Understand data mining problems and implement the data warehouse  
|                                          | CS651.2 Demonstrate association rules for a given data pattern.  
|                                          | CS651.3 Discuss between classification and clustering solution. |
| 29 OPERATIONS RESEARCH (15CS653)         | CS653.1 Explain optimization techniques for various problems.  
<p>|                                          | CS653.2 Understand the given problem as transportation |</p>
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS653.3</td>
<td>Illustrate game theory for decision support system.</td>
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<tr>
<td>CS664.1</td>
<td>Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.</td>
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<tr>
<td>CS664.2</td>
<td>Demonstrate proficiency in handling Strings and File Systems.</td>
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<tr>
<td>CS664.3</td>
<td>Implement Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.</td>
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<tr>
<td>CS664.4</td>
<td>Interpret the concepts of Object-Oriented Programming as used in Python.</td>
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<tr>
<td>CS664.5</td>
<td>Implement exemplary applications related to Network Programming, Web Services and Databases in Python.</td>
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<tr>
<td>CS71.1</td>
<td>Adapt HTML and CSS syntax and semantics to build web pages.</td>
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<tr>
<td>CS71.2</td>
<td>Construct and visually format tables and forms using HTML and CSS</td>
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<tr>
<td>CS71.3</td>
<td>Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically.</td>
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<tr>
<td>CS71.4</td>
<td>Appraise the principles of object oriented development using PHP</td>
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<tr>
<td>CS71.5</td>
<td>Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.</td>
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<tr>
<td>IS72.1</td>
<td>Design and implement codes with higher performance and lower complexity</td>
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<tr>
<td>IS72.2</td>
<td>Be aware of code qualities needed to keep code flexible</td>
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<tr>
<td>IS72.3</td>
<td>Experience core design principles and be able to assess the quality of a design with respect to these principles.</td>
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<tr>
<td>IS72.3</td>
<td>Capable of applying these principles in the design of object oriented systems.</td>
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<tr>
<td>IS72.4</td>
<td>Demonstrate an understanding of a range of design patterns. Be capable of comprehending a design presented using this vocabulary.</td>
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<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Course Description</td>
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</tbody>
</table>
| 33          | MACHINE LEARNING (15CS73) | **IS72.5** Be able to select and apply suitable patterns in specific contexts  
**CS73.1** Identify the problems for machine learning. And select the either supervised, unsupervised or reinforcement learning.  
**CS73.2** Explain theory of probability and statistics related to machine learning  
**CS73.3** Investigate concept learning, ANN, Bayes classifier, k nearest neighbor, Q. |
| 34          | CLOUD COMPUTING AND ITS APPLICATIONS (15CS742) | **CS742.1** Explain cloud computing, virtualization and classify services of cloud computing  
**CS742.2** Illustrate architecture and programming in cloud  
**CS742.3** Describe the platforms for development of cloud applications and List the application of cloud. |
| 35          | INFORMATION AND NETWORK SECURITY (15CS743) | **CS743.1** Analyze the Digitals security lapses  
**CS743.2** Illustrate the need of key management  
**CS743.3** Indicate the location of a security process in the given system |
| 36          | STORAGE AREA NETWORKS (15CS754) | **CS754.1** Identify key challenges in managing information and analyze different storage networking technologies and virtualization  
**CS754.2** Explain components and the implementation of NAS  
**CS754.3** Describe CAS architecture and types of archives and forms of virtualization  
**CS754.4** Illustrate the storage infrastructure and management activities |
| 37          | INTERNET OF THINGS TECHNOLOGY(15CS81) | **CS81.1** Interpret the impact and challenges posed by IoT networks leading to new architectural models.  
**CS81.2** Compare and contrast the deployment of smart objects and the technologies to connect them to network.  
**CS81.3** Appraise the role of IoT protocols for efficient network communication.  
**CS81.4** Elaborate the need for Data Analytics and Security in IoT.  
**CS81.5** Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry. |
<p>| 38          | BIG DATA ANALYTICS | <strong>CS82.1</strong> Master the concepts of HDFS and MapReduce |</p>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(15CS82)</td>
<td>Framework</td>
<td>CS82.2 Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop Administration. CS82.3 Recognize the role of Business Intelligence, Data warehousing and Visualization in decision making. CS82.4 Infer the importance of core data mining techniques for data analytics. CS82.5 Compare and contrast different Text Mining Techniques.</td>
</tr>
<tr>
<td>39</td>
<td>System Modeling and Simulation (15CS834)</td>
<td>CS834.1 Explain the system concept and apply functional modeling method to model the activities of a static system. CS834.2 Describe the behavior of a dynamic system and create an analogous model for a dynamic system. CS834.3 Simulate the operation of a dynamic system and make improvement according to the simulation results.</td>
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</tbody>
</table>
V SEMESTER

MANAGEMENT AND ECONOMICS
Course Code 17ME51

COURSE OUTCOMES

At the end of completion of the course, students will be

CO1: Able to explain the Overview of Management.

CO2: Able to explain the Planning, Organizing, Staffing, Directing and Controlling of Management.

CO3: Able to explain the basics of Economics.

CO4: Able to determine the interest by various Methods.

CO5: Able to Evaluate and Select Economic Models from Various Alternatives.

CO6: Able to determine the Cost and Depreciation of Product.

DYNAMICS OF MACHINES
Course Code 17ME52

COURSE OUTCOMES (CO’S)
After studying this course, students will be able to:

**CO Statements**

CO1. To gain the knowledge static and dynamic equilibrium conditions of mechanisms subjected forces and couple, with and without friction.

CO2. Analyse the mechanisms for static and dynamic equilibrium.

CO3. To understand the balancing principles of rotating and reciprocating masses, governors and gyroscopes.

CO4. Analyse the balancing of rotating and reciprocating masses, governors and gyroscopes.

CO5. To understand vibrations characteristics of single degree of freedom systems.

CO6. Characterise the single degree freedom systems subjected to free and forced vibrations with and without damping.

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**TURBO MACHINES**

Course Code **17ME53**

**COURSE OUTCOMES (CO’S)**

At the end of the course, the student will be able to:

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 OUTCOMES (CO’S)

After studying this course, students will be able to:

CO1. To understand the various steps involved in the Design Process.

CO2. To explain the principles involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity, functional and manufacturing requirements.

CO3. To explain the principles involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity, functional and manufacturing requirements.

CO4. To learn to use national and international standards, standard practices, standard data, catalogs, and standard components used in design of machine elements.

CO5. Develop the capability to design elements like shafts, couplings, welded joints, screwed joints, and power screws.
NON TRADITIONAL MACHINING

Course Code 17ME554

COURSE OUTCOMES (CO’S)

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.

**FLUID MECHANICS & MACHINERY LAB**

**Course Code 17MEL57**

**COURSE OUTCOMES (CO’S)**

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

**ENERGY LAB**

17MEL58

**COURSE OUTCOMES (CO’S)**

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 report the remedies.

CO5 Determine the energy flow pattern through the I C Engine

CO6 Exhibit his competency towards preventive maintenance of IC engines.
FINITE ELEMENT ANALYSIS

17ME61

COURSE OUTCOMES (CO’S)

CO1. Understand the concepts behind formulation methods in FEM.
CO2. Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
CO3. Develop element characteristic equation and generation of global equation.
CO4. Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.

Computer Integrated Manufacturing

17ME62

COURSE OUTCOMES (CO’S)
CO1. Explain the basics of automated manufacturing systems and mathematical model to analyze the different types of automated flow lines.

CO2. Explain the different types of manufacturing planning and control system using graphics software.

CO3. Explain the Flexible manufacturing system.

CO4. Analyze the automated flow lines by using line balancing techniques.

CO5. Write CNC part program and programs for Robots.

CO6. Explain the basic principles of additive manufacturing systems and the applications of IOT.

Heat Transfer
17ME63

COURSE OUTCOMES (CO’S)

At the end of the course, the student will be able to:

CO1 Determine the conduction heat transfer of steady and unsteady state.

CO2 Analyze one-dimensional and two-dimensional steady and unsteady state heat conduction using numerical methods.

CO3 Analyze the radiation heat transfer by applying fundamental laws

CO4 Determine convective heat transfer using non-dimensional numbers.

CO5 Determine performance parameters using LMTD and NTU methods.

CO6 Determine heat transfer co-efficient of boiling and condensation.
DESIGN OF MACHINE ELEMENTS II

17ME64

COURSE OUTCOMES (CO’S)

CO1  Apply engineering design tools to product design.
CO2 Design mechanical systems involving springs, belts and pulleys.
CO3  Design different types of gears and simple gear boxes for different applications.
CO4  Design brakes and clutches.
CO5  Design hydrodynamic bearings for different applications.
CO6 Select Anti friction bearings for different applications using the manufacturers, catalogue.
CO7 Develop proficiency to generate production drawings using CAD software.
CO7 Become good design engineers through learning the art of working in a team with morality and ethics.

AUTOMOBILE ENGINEERING

17ME655

COURSE OUTCOMES (CO’S)

CO1 To identify the different parts of an automobile and it’s working
CO2 To understand the working of transmission and braking systems
CO3 To comprehend the working of steering and suspension systems
CO4 To learn various types of fuels and injection systems
CO5 To know the cause of automobile emissions, its effects on environment and methods to reduce the emissions.

TOTAL QUALITY MANAGEMENT
17ME664

COURSE OUTCOMES (CO’S)

CO1 Explain the various approaches of TQM
CO2 Infer the customer perception of quality
CO3 Analyze customer needs and perceptions to design feedback systems.
CO4 Apply statistical tools for continuous improvement of systems
CO5 Apply the tools and technique for effective implementation of TQM.

Automation & Robotics

Subject code: 17ME563

COURSE OUTCOMES (CO’S)

The students will be able to

CO1 Explain the concept of automation and understand types of hardware components used in automation.
CO2  Describe the automated production lines and assembly systems
CO3 Sketch various parts of robot machines and able to identify the parts.
CO4  Distinguish the spatial descriptions and transformation of robotic arms.
CO5  Describe the different programming language and automating subtasks in olp systems

Heat Transfer Lab

COURSE OUTCOMES (CO’S)

CO1 Perform experiments to determine the thermal conductivity of a metal rod
CO2 Conduct experiments to determine convective heat transfer coefficient for free and forced convection and correlate with theoretical values.
CO3. Estimate the effective thermal resistance in composite slabs and efficiency in pin-fin
CO4 Determine surface emissivity of a test plate
CO5 Estimate performance of a refrigerator and effectiveness of fin
CO6 Calculate temperature distribution of study and transient heat conduction through plane wall, cylinder and fin using numerical approach.
Modeling and Analysis Lab (FEA)

17MEL68

COURSE OUTCOMES (CO’S)

CO1 Demonstrate the basic features of an analysis package.
CO2 Use the modern tools to formulate the problem, and able to create geometry, discretize, apply boundary condition to solve problems of bars, truss, beams, plate to find stress with different loading conditions.
CO3 Demonstrate the deflection of beams subjected to point, uniformly distributed and varying loads further to use the available results to draw shear force and bending moment diagrams.
CO4 Analyze the given problem by applying basic principle to solve and demonstrate 1D and 2D heat transfer with conduction and convection boundary conditions.
CO5 Carry out dynamic analysis and finding natural frequencies for various boundary conditions and also analyze with forcing function.

VII SEMESTER
ENERGY ENGINEERING
15ME71

COURSE OUTCOMES (CO’S)

At the end of the course, the student will be able to:
CO1 Summarize the basic concepts of thermal energy systems,
CO2 Identify renewable energy sources and their utilization.

CO3 Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
CO4 Understand principles of energy conversion from alternate sources including wind, geothermal, ocean, biomass, biogas.
CO5 Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
CO6 Identify methods of energy storage for specific applications

**FLUID POWER SYSTEMS**
15ME72

**COURSE OUTCOMES (CO’S)**

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 electrohydraulics, electro-pneumatics for a given application.
CO4 Select and size the different components of the circuit.
CO5 Develop a comprehensive circuit diagramby integrating the components selected for the given application.
CONTROL ENGINEERING
15ME73

COURSE OUTCOMES (CO’S)

CO1: Recognize control system and its types, control actions
CO2: Determine the system governing equations for physical models (Electrical, Thermal, Mechanical, Electro Mechanical)
CO3: Calculate the gain of the system using block diagram and signal flow graph
CO4: Illustrate the response of 1st and 2nd order systems
CO5: Determine the stability of transfer functions in complex domain and frequency domain
CO6: Employ state equations to study the controllability and observability

TRIBOLOGY
15ME742

COURSE OUTCOMES (CO’S)

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.
MECHATRONICS
15ME753

COURSE OUTCOMES (CO’S)

On completion of this subject, students will be able to:

CO1 Illustrate various components of Mechatronics systems.
CO2 Assess various control systems used in automation.
CO3 Develop mechanical, hydraulic, pneumatic and electrical control systems.

DESIGN LABORATORY
15MEL76

COURSE OUTCOMES

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

CO1 To understand the working principles of machine elements such as Governors, Gyroscopes etc.,
CO2 To identify forces and couples in rotating mechanical system components.

CO5 Apply the principles of surface engineering for different applications of tribology.
CO3  To identify vibrations in machine elements and design appropriate damping methods and to determine the critical speed of a rotating shaft.
CO4  To measure strain in various machine elements using strain gauges.
CO5 To determine the minimum film thickness, load carrying capacity, frictional torque and pressure distribution of journal bearing.
CO6  To determine strain induced in a structural member using the principle of photo-elasticity.

COMPTER INTEGRATED MANUFACTURING LAB
15MEL77

COURSE OUTCOMES (CO’S)

CO1 Generate CNC Lathe part program for Turning, Facing, Chamfering, Grooving, Step turning, Taper turning, Circular interpolation etc.

CO2 Generate CNC Mill Part programming for Point to point motions, Line motions, Circular interpolation, Contour motion, Pocket milling- circular, rectangular, Mirror commands etc.

CO3 Use Canned Cycles for Drilling, Peck drilling, Boring, Tapping, Turning, Facing, Taper turning
Thread cutting etc.

CO4 Simulate Tool Path for different Machining operations of small components using CNC Lathe & CNC Milling Machine.

CO5 Use high end CAM packages for machining complex parts; use state of art cutting tools and related cutting parameters; optimize cycle time.

CO6 Understand & write programs for Robotcontrol; understand the operating principles of hydraulics, pneumatics and electropneumatic systems. Apply this knowledge to automate & improve efficiency of manufacturing.
On completion of this subject, students will be able to:

CO1 Understand the meaning, definitions, scope, need, phases and techniques of operations research.

CO2 Formulate as L.P.P and derive optimal solutions to linear programming problems by graphical method, Simplex method, Big-M method and Dual Simplex method.

CO3 Formulate as Transportation and Assignment problems and derive optimum solutions for transportation, Assignment and travelling salesman problems.

CO4 Solve problems on game theory for pure and mixed strategy under competitive environment.

CO5 Solve waiting line problems for M/M/1 and M/M/K queuing models.

CO6 Construct network diagrams and determine critical path, floats for deterministic and PERT networks including crashing of Networks.

CO7 Determine minimum processing times for sequencing of n jobs-2 machines, n jobs-3machines, n jobs-m machines and 2 jobs-n machines using Johnson’s algorithm.

ADDITIVE MANUFACTURING
15ME82

COURSE OUTCOMES (CO’S)

CO1 Understand the different process of Additive Manufacturing, using Polymer, Powder and Nano materials manufacturing.

CO2 Analyse the different characterization techniques.

CO3 Describe the various NC, CNC machine programming and Automation techniques.
COURSE OUTCOMES (CO’S)

Course Outcomes: Student will be able to

CO1 Explain the various strategies of PLM and Product Data Management
CO2 Describe decomposition of product design and model simulation
CO3 Apply the concept of New Product Development and its structuring.
CO4 Analyze the technological forecasting and the tools in the innovation
CO5 Apply the virtual product development and model analysis

Programme outcomes

Engineering Graduates will be able to:

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

2. Problems Analysis: Identify, formulate, review research literature, and analyze complex, engineering problems reaching sustained conclusions using first principles of mathematics, natural science and engineering science.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components of process that meet the specified needs with appropriate consideration for the public health and safety, and cultural, societal, and environmental consideration.

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 information to provide valid conclusions.

5. Modern tool usage: create, select, and apply appropriate techniques, resource and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply the reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issue and the consequent responsibility relevant to the professional engineering practice.

7. Environment and sustainability: Understanding the impact of the professional engineering solution in the social and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethics principle and commit to professional ethic and responsibility and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as member or leader in diverse team, and in multidisciplinary setting.

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

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in team, to manage projects and in multidisciplinary environments.

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

**Programme Specific Outcomes**

**Mechanical Engineering Graduates will be able to:**

1. Model, analyze, design and realize physical systems, material with its properties, components or process by applying principles of Mechanical engineering.

2. Work professionally in industries or as an entrepreneur by analyse and design the machine components, by applying manufacturing and management practices.

3. Learn the knowledge of computer software and its application, artificial intelligence, IOT applicable for mechanical engineering.
Department of MBA

17MBA11: Management Organisational Behaviour

1. Comprehend & correlate all the management functions which are happening around with fundamental concepts and principles of management.
2. Understand the overview of management, theory of management and practical applications of the same.
3. Effectively use their skills for self-grooming, working in groups and to achieve organizational goals.
4. Demonstrate their acumen in applying managerial and behavioral concept in real world/situation.
5. Understand and demonstrate their exposure on recent trends in

17MBA12: Managerial Economics

1. The student will understand the application of Economic Principles in Management decision making.
2. The student will learn the micro economic concepts and apply them for effective functioning of a Firm and Industry.
3. The Student will be able to understand, assess and forecast Demand.
4. The student will apply the concepts of production and cost for optimization of production.
5. The student will design Competitive strategies like pricing, product differentiation etc. and marketing according to the market structure.
6. The student will be able to identify, assess profits and apply BEP for decision making.

17MBA21: Human Resource management

1. Synthesize information regarding the effectiveness of recruiting methods & selection procedures.
2. Identify the various training methods and design a training program.
3. Design a job description and job specification for various levels of employees.
4. List out the regulations governing employee benefit practices.

17MBA22: Financial Management

1. Understand the basic financial concepts
2. Apply time value of money
3. Evaluate the investment decisions
4. Analyze the capital structure and dividend decisions.
5. Estimate working capital requirements
17MBA23: Research Methods
1. Understand various research approaches, techniques and strategies in the appropriate in business.
2. Apply a range of quantitative / qualitative research techniques to business and day to day management problems
3. Demonstrate knowledge and understanding of data analysis, interpretation and report writing
4. Develop necessary critical thinking skills in order to evaluate different research approaches in Business.

17MBA25: Strategic Management
1. Formulate a strategic plan that operationalizes the goals and objectives of the firm.
2. Use management concepts to analyze complex business situations
3. Associate with various Strategic Management models for Business situations
4. Ability to evaluate and critique theories models in corporate environment

17MBA26: ENTREPRENEURSHIP DEVELOPMENT
1. Display keen interest and orientation towards entrepreneurship
2. Develop a business plan
3. Become aware about various sources of funding for an entrepreneur including financial institutions, venture capitalists and Angel Investors
4. Gain consciousness towards social entrepreneurship and rural entrepreneurship opportunities

17MBA MM301: Consumer Behaviour
1. Explain the background and concepts vital for understanding Consumer Behaviour.
2. Identify the role of variables that determines Consumer Behaviour in Social & cultural domain.
3. Identifying the psychological and behavioral practices adopted by organizations to enhance the consumer behavior

17MBA MM302: Retail Management
1. Find out the contemporary retail management, issues, and strategies.
2. Evaluate the recent trends in retailing and its impact in the success of modern business.
3. Relate store management and visual merchandising practices for effective retailing.

17MBA MM303: SERVICES MARKETING
1. Develop an understanding about the various concepts and importance of Services Marketing.
2. Enhance knowledge about emerging issues and trends in the service sector
3. Learn to implement service strategies to meet new challenges
17MBA FM301: Principles and Practices of Banking

1. Understand the banking system in India
2. Know the nature of banker – customer relationship
3. Make use of Negotiable instruments practically
4. Have familiarity in using banking technologies like internet banking, Mobile banking, NEFT, ECS etc.
5. Understand the concept of international banking and management of asset and liability in banks

17MBA FM302: INVESTMENT BANKING AND FINANCIAL SERVICES

1. Understand the functioning of Investment banking
2. Be aware of operation connected with depositories and custodians
3. Know how financial services like factoring, venture capital, leasing and hire purchase are provided in the financial system.
4. Understand the working of Housing finance and non-banking finance companies.
5. Identify the developments happening in micro finance, credit rating and securitization system

17MBA FM303: Investment Management

1. Understand the process of investments.
2. Get an insight into functioning of stock markets in India and abroad.
3. Have insight into the relationship of the risk and return. Have familiarity of the fundamental and technical analysis
4. Learn the Theories of Portfolio management and also the tools and techniques for efficient portfolio management.

17MBA HR301: INDUSTRIAL RELATIONS AND LEGISLATIONS

1. Gain the insights of IR practice in the industry.
2. Develop the knowledge related to employee-management relations
3. Implementation of various industrial acts

17MBA HR302: RECRUITMENT & SELECTION

1. Learn the various recruitment policies and procedures.
2. Equip with conceptual framework of selection procedures.
3. Gain insights of the latest concepts and techniques used in recruitment and selection.

17MBA HR303: COMPENSATION AND BENEFITS

1. Gain insights of various conceptual aspects of Compensation and Benefits.
2. Determine the performance based compensation system for business excellence.
3. Understand the Legal & Administrative Issues in Compensation Global Compensation
17MBA MM401: Sales Management

1. Know the distinction between the skills required for selling and sales management.
2. Develop a plan for organizing, staffing and training the sales force.
3. Organize sales territories to maximize selling effectiveness.

17MBA MM402: INTEGRATED MARKETING COMMUNICATIONS

1. Define and apply knowledge of various aspects of managerial decision making related to marketing communications strategy and tactics.
2. Ability to create an integrated marketing communications plan which includes promotional strategies.
3. Explain the role of IMC in the overall marketing & Use effectiveness measures to evaluate IMC strategies.

17MBA MM403: E-Marketing

1. Recognize appropriate e-marketing objectives.
2. Appreciate the e-commerce framework and technology.
3. Illustrate the use of search engine marketing, online advertising and marketing strategies.

17MBA FM401: Mergers, Acquisitions & Corporate Restructuring

1. Understand corporate merger and acquisition activity.
2. Analyze the mergers & acquisition deals that have taken place in the recent past.
3. Understand synergies of mergers & acquisition deals.
4. Compute the valuation associated with M&A.
5. Understand the human and cultural aspects of M&A’s.

17MBA FM402: Risk Management and Insurance

1. Understand the process of identifying the risk.
2. Recognize the complexities involved in risk identification and measurement.
3. Be acquainted with the function of Insurance in risk management.
4. Be aware of various types of insurance contracts.
5. Understand working of insurance companies.

17MBA FM403: Tax Management

1. Understand the process of computing residential status.
2. Realize the complexities involved in tax liability of Individuals.
3. Know the corporate tax system.
17MBA HR401: PUBLIC RELATIONS

1. Gain the insights of Public relations principles and practices.
2. Learn the various theories of mass communication
3. Understand the various issues in crisis management

17MBA HR402: WORKPLACE ETHICS AND VALUE SYSTEMS

1. Learn the principles and practices of workplace ethics.
2. Understand the concepts of corporate governance and ethics.
3. Gain insights of Discrimination and Harassment at Workplace

17MBA HR403: International Human Resource Management

1. Apply the concepts and knowledge about the range of Human Resource functions.
2. Deploy the expatriate employees and expatriate failures on international assignments.
3. Evaluate the effects of different Human Resource and International Industrial Relations strategies adopted by multinational organizations
Department of MCA

Course outcome 2017-2018

PROGRAM SPECIFIC OUTCOME (PSOs):

- **PSO1**: Understand and apply the computing techniques with mathematics and industrial concepts for solving real time industrial problems.
- **PSO2**: Analyze, design, develop, test, deploy and maintain the software applications with latest computing tools and technologies.

Program Outcomes (PO)

- **PO1**: Understand and apply the fundamental principles of mathematics, statistics and knowledge of computer science for solving real time problems.
- **PO2**: Identify, analyze, and formulate the real world requirements in computing domain for solving problems.
- **PO3**: Design and estimate the computer system components, sub-systems and appropriate tools for developing solutions for complex problems.
- **PO4**: Use latest tools and technique needed for hard computing practices.
- **PO5**: Use right platform on design and execution for performance.
- **PO6**: Work effectively as an individual as well as working in a team.
- **PO7**: Developing communication skills to communicate with different stakeholders to manage software projects.
- **PO8**: Understand the societal, environmental, health, legal, ethical issues and its impact with respect to computing and professional practice.
- **PO9**: Design, execute and interpret the software with real time data and synthesis the information to reach suitable conclusions.
| No. | Code   | Course                        | CO1: Understand constraints and opportunities of wireless and mobile networks for Internet of Things.  
CO2: Analyze the societal impact of IoT security events.  
CO3: Develop critical thinking skills.  
CO4: Analyze, design or develop parts of an Internet of Things solution and map it toward selected business model(s)  
CO5: Evaluate ethical and potential security issues related to the Internet of Things. |
|-----|--------|-------------------------------|------------------------------------------------------------------------------------------|
| 1   | 17MCA11| Data structures using C       | CO1: Understand and experience the UNIX environment, File system and hierarchy.  
CO2: Demonstrate commands to extract, interpret data for further processing.  
CO3: Apply commands to perform different tasks on various applications  
CO4: Analyze the usage of different shell commands, variables and AWK filtering.  
CO5: Evaluate different commands with sample shell scripts |
| 2   | 17MCA12| Unix Programming              | CO1: Understand the fundamentals of web and thereby develop web applications using various development languages and tools.  
CO2: Build the ability to select the essential technology needed to develop and implement web applications  
CO3: Use Scripting language utilities for static and dynamic environment  
CO4: Design XML document with presentation using CSS and XSLT.  
CO5: Develop CGI applications using PERL |
| 3   | 17MCA13| Web Technologies              | CO1: Understand the Basics of Digital System  
CO2: Understand the Basics of Computer System Organization  
CO3: Apply the concepts of the number system in Designing Digital System.  
CO4: Analyze the need of Logic circuits in digital system  
CO5: Create logic circuits for real time requirement |
| 4   | 17MCA14| Computer Organization         | CO1: Use the logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers.  
CO2: Calculate numbers of possible outcomes of elementary |
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<td>6</td>
<td>17MCA16</td>
<td>DATA STRUCTURES USING C LABORATORY</td>
</tr>
</tbody>
</table>
|   |   | CO1: Apply data structure concepts to develop interactive applications in C.  
|   |   | CO2: Linear data structures and their applications such as Stacks, Queues and Lists  
|   |   | CO3: Non-Linear Data Structures and their Applications  
|   |   | CO4: Be fluent in the use of different types of sorting and searching techniques  
| 7 | 17MCA17 | UNIXProgrammingLaboratory |
|   |   | CO1: Understand the Unix programming environment.  
|   |   | CO2: Be fluent in the use of Vi editor.  
|   |   | CO3: Be able to design and implement shell scripts to manage users with different types of permission and file based applications.  
|   |   | CO4: Be fluent to write Awk scripts.  
| 8 | 17MCA18 | WEB PROGRAMMING LABORATORY |
|   |   | CO1: Understand the concept and usages web based programming techniques.  
|   |   | CO2: Learning and developing XHTML documents using JavaScript and CSS  
|   |   | CO3: To be familiar in the use of CGI and Perl programs for different types of server side applications.  
|   |   | CO4: Design and implement user interactive dynamic web based applications.  
| 9 | 17MCA21 | PYTHON PROGRAMMING |
|   |   | CO1: Understand and comprehend the basics of python programming.  
|   |   | CO2: Apply knowledge in real time applications.  
|   |   | CO3: Understands about files and its applications.  
| 10 | 17MCA22 | Object Oriented Programming Using C++ |
|   |   | CO1: Differentiate between object oriented programming and procedure oriented programming & Disseminate the importance of Object oriented programming  
|   |   | CO2: Apply C++ features such as Classes, objects, constructors, destructors, inheritance, operator overloading, and Polymorphism, Template and exception handling in program design and implementation.  
|   |   | CO3: Use C++ to demonstrate practical experience in developing object-oriented solutions.  
|   |   | CO4: Analyze a problem description and build object-
<table>
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<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Course Outcomes</th>
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</table>
| 11 17MCA23  | DATABASE MANAGEMENT SYSTEM        | CO1: Demonstrate the fundamentals of data models and conceptualize and depict a database system and Make use of ER diagram in developing ER Model  
 CO2: To Summarize the SQL and relational database design.  
 CO3: Illustrate transaction processing, concurrency control techniques and recovery  
 CO4: Inference the database design in the real world entities.                                                                                                                                                                      |
| 12 17MCA24  | Operating Systems                 | CO1: Understand the Basics of Computer and Operating Systems Structure  
 CO2: Realize the concept of Process Management and Mutual Execution  
 CO3: Understand the concepts of the Deadlock and different approaches to memory management.  
 CO4: Learn the concepts of file system  
 CO5: Understand the concepts of Computer Security.                                                                                                                                                                               |
| 13 17MCA25  | SYSTEM SOFTWARE                   | CO1: Understand the introductory concepts of system software, SIC and SIC/XE machine architecture.  
 CO2: Understand the design and implementation of Assemblers with implementation examples.  
 CO3: Design and implement the linkers and loaders, macro processors and respective implementation examples.  
 CO4: Learn the basic design and working of compilers.                                                                                                                                                                               |
| 14 17MCA26  | PYTHON PROGRAMMING LABORATORY     | CO1: Apply object-oriented programming concepts to develop dynamic interactive Python applications.  
 CO2: Use the procedural statements: assignments, conditional statements, loops, method calls and arrays  
 CO3: Design, code, and test small Python programs with a basic understanding of top-down design.  
 CO4: Learn how to create GUI and solve real-world problem using language idioms, data structures and standard library                                                                                                                                 |
| 15 17MCA27  | OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY | CO1: Apply and implement major programming and object oriented concepts like function overloading, operator overloading, Encapsulations, and inheritance, message passing to solve real-world problems.  
 CO2: Use major C++ features such as Virtual functions, Templates for data type independent designs and File I/O to  

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Course Objectives</th>
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| CO1: Understand, appreciate the underlying concepts of database technologies  
CO2: Able to create database with different types of integrity constraints and use the SQL commands such as DDL, DML, DCL, TCL to access data from database objects.  
CO3: Design and implement a database schema for a given problem domain  
CO4: Perform embedded and nested queries  
CO5: Take up real world problems independently | DATABASE MANAGEMENT SYSTEMS LABORATORY | 16 17MCA28                                                                                                                                                                                                         |
| CO1: Understand the types of Networks & Communication medias.  
CO2: Identify the components required to build different types of networks  
CO3: Understand the functionalities needed for data communication into layers  
CO4: Choose the required functionality at each layer for given application  
CO5: Understand the working principles of various application protocols | Computer Networks | 17 17MCA31                                                                                                                                                    |
| CO1: Understand the basic programming constructs of Java. Apply suitable OOP concepts to develop Java programs for a given scenario.  
CO2: Illustrate the concepts of Generalization and run time polymorphism applications  
CO3: Exemplify the usage of Packages, Interfaces, Exceptions and Multithreading  
CO4: Demonstrate Enumerations, Wrappers, Auto boxing, Generics, collection framework and I/O operations  
CO5: Implement the concepts of Networking using Java network classes | Java Programming | 18 17MCA32                                                                                                                                                   |
| CO1: Categorize problems based on their characteristics and practical importance.  
CO2: Develop Algorithms using iterative/recursive approach  
CO3: Compute the efficiency of algorithms in terms of asymptotic notations  
CO4: Design algorithm using an appropriate design paradigm for solving a given problem  
CO5: Classify problems as P, NP or NP Complete  
CO6: Implement algorithms using various design strategies | Analysis and Design of Algorithms | 19 17MCA33                                                                                                                                                   |
| No. | Code     | Course                      | CO1: Categorize problems based on their characteristics and practical importance.  
|     |          |                            | CO2: Apply the correct process models for software development.  
|     |          |                            | CO3: Apply the techniques, skills, and modern engineering tools necessary for engineering practice.  
|     |          |                            | CO4: Define, formulate and analyze a problem as per the testing techniques.  
|     |          |                            | CO5: Apply new Generation of Software Engineering Technology to Meet Current and Future Industrial Challenges of Emerging Software Trends  
| 20  | 17MCA34  | Software Engineering       | CO1: Understand the basic terminologies used for computer networking.  
|     |          |                            | CO2: Understand the functions of layers in the Internet Model.  
|     |          |                            | CO3: Demonstrate application layer protocols used for process to process communication.  
|     |          |                            | CO4: Demonstrate subnetting and routing mechanisms for a given network topology. Exemplify link layer functionalities.  
|     |          |                            | CO5: Describe the components and working of wireless networks.  
| 21  | 17MCA36  | Computer Networks          | CO1: Understand Java programming language fundamentals and run time environment.  
|     |          | Laboratory                 | CO2: Acquire knowledge and skill necessary to write java programs.  
|     |          |                            | CO3: Learn the object oriented concepts and its implementation in Java  
|     |          |                            | CO4: Implement the multithreading and client side programming.  
| 22  | 17MCA37  | Java Programming Laboratory| CO1: Implement the concepts of time and space complexity, divide-and-conquer strategy, dynamic programming, greedy and approximate algorithms.  
|     |          |                            | CO2: Describe the methodologies of how to analyze an algorithm  
|     |          |                            | CO3: Choose a better algorithm to solve the problems  
| 23  | 17MCA38  | Analysis and Design of     | CO1: Identify which of the four main different types of intellectual property rights may be presented by an output  
|     |          | Algorithms Laboratory      | CO2: Analyze an innovative or creative output in terms of intellectual property rights generated  
|     |          |                            | CO3: Discuss the appropriateness, or not, of registering an
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO4:</td>
<td>Apply the appropriate ownership rules to intellectual property he/she has been involved in creating</td>
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<tr>
<td>CO5:</td>
<td>Suggest ways of exploiting intellectual property rights created in his/her own work.</td>
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<tr>
<td>17MCA352</td>
<td>ENTERPRISE RESOURCE PLANNING</td>
<td>CO1: Acquire knowledge of - Benefits of ERP, Process Re-engineering - Project management and Monitoring CO2: Analyze the performance of - Project implementations - Quality management CO3: Know how ERP evolves in market place CO4: Develop the ERP system, ERP with E-Commerce &amp; Internet</td>
</tr>
<tr>
<td>17MCA353</td>
<td>MIS &amp; E-Commerce</td>
<td>CO1: Recognize the roles and uses of technology in business systems, operations and describe organizational structure. CO2: Equip the students with preliminaries of technologies used in business information systems. CO3: Familiarize students with the Business applications and E-Commerce initiatives.</td>
</tr>
<tr>
<td>17MCA354</td>
<td>CYBER SECURITY</td>
<td>CO1: Define and illustrate cyber security concepts and applications CO2: Analyze the working of cyber security principles to system design CO3: Illustrate appropriate techniques to solve cyber security threats CO4: Evaluate and implement cyber security through network security protocols</td>
</tr>
<tr>
<td>17MCA41</td>
<td>ADVANCED JAVA PROGRAMMING</td>
<td>CO1: Learn the concept of Servlet and its life cycle CO2: Understand JSP tags and its services CO3: Create packages and interfaces CO4: Build Database connection CO5: Develop Java Server Pages applications using JSP Tags. CO6: Develop Enterprise Java Bean Applications</td>
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<td><strong>30</strong></td>
<td>17MCA43</td>
<td>SOFTWARE TESTING AND PRACTICES</td>
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</table>
|   |   | CO1: Acquire knowledge of basic principles and knowledge of software testing and debugging and test cases.  
CO2: Understand the perceptions on testing like levels of testing, generalized pseudo code and with related examples  
CO3: Study the various types of testing.  
CO4: Analyze the difference between functional testing and structural testing.  
CO5: Analyze the performance of fault based testing. |
| **31** | 17MCA46 | ADVANCED JAVA PROGRAMMING LABORATORY |
|   |   | CO1: Designing HTML pages to demonstrate Java Servlets, JSP, Bean and EJB programs.  
CO2: Implementing Dynamic HTML using Servlet and demonstration of service methods, auto web page refresh, Session tracking using cookie and Http Session in Servlet.  
CO3: Learn the fundamental of connecting to the database.  
CO4: Demonstrate JSP (page attributes, action tags and all basic tags) and types of EJB application |
| **32** | 17MCA47 | ADVANCED WEB PROGRAMMING LABORATORY |
|   |   | CO1: Understand, analyze and apply the role of server side scripting languages.  
CO2: Build web application using PHP, Ruby, jQuery, XML and store values in MySQL.  
CO3: Build web applications consisting of graphs using D3.JS.  
CO4: Analyze a web project and identify its elements and attributes in comparison to traditional projects. |
| **33** | 17MCA48 | SOFTWARE TESTING LABORATORY |
|   |   | CO1: Analyze the performance of fault based testing, planning and Monitoring the process, Documentation testing  
CO2: This course provides to experience on software testing projects using software testing tools.  
CO3: Understand the process to be followed in software development life cycle.  
CO4: Practical solutions to the problems  
CO5: Define, formulate and analyze a problem. |
| **34** | 17MCA441 | ADVANCED COMPUTER NETWORKS |
|   |   | CO1: Understand the terminology and concepts of TCP-IP reference model and IPV6 message format and its services.  
CO2: Acquire the concept of protocols, network interfaces, and design/performance issues in Local Area Networks and wide area networks.  
CO3: Analyze the difference between wireless networks and satellite network.  
CO4: Evaluate the performance of TCP/IP over asymmetric...
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<tr>
<th>Course Code</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Course Objectives</th>
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</table>
| 35         | 17MCA442     | DATA WAREHOUSING AND DATA MINING                | CO1: Learn the concept of Data warehousing and OLAP.  
CO2: Understand storage and retrieval technique of data from DATA CUBE.  
CO3: Analyze different types of data and different preprocessing techniques.  
CO4: Evaluate various Association algorithms and its applications.  
CO5: Apply different Classification techniques.  
CO6: Evaluate different types of classifiers.  
CO7: Analyze different clustering techniques and their applications. |
| 36         | 17MCA443     | SOFTWARE ARCHITECTURE                           | CO1: Acquire knowledge of  
- working principles, characteristics and basic applications of Architectural patterns.  
- project life cycle context.  
- how the architecture is influenced.  
- the quality attributes of architecture.  
CO2: Modeling quality attributes through  
- check lists.  
- experiments.  
- back-of-the envelope analysis.  
CO3: Understand the techniques of requirements gathering through interviewing stake holders, etc.  
CO4: Understand different types of design patterns. |
| 37         | 17MCA444     | CRYPTOGRAPHY AND NETWORK SECURITY               | CO1: Identify common network security vulnerabilities/attacks;  
CO2: Understand the foundations of Cryptography and network security.  
CO2: Understand encryption and decryption of messages using block ciphers  
CO3: Demonstrate detailed knowledge of the role of encryption to protect data.  
| 38         | 17MCA451     | WIRELESS COMMUNICATION & MOBILE TECHNOLOGIES    | CO1: Understand the classification of devices, limitations of devices, interfaces, protocol and system Architecture  
CO2: Understand the importance of Wireless Medium Access control and CDMA based communication and its Applications.  
CO3: Understand the concepts of Network layer, Transport layer.  
CO4: Analyze the working of Data Dissemination and |
| 39 | 17MCA452 | BIG DATA ANALYTICS | Broadcasting Systems.  
CO5: Understand and apply the Data Synchronization Server and Management Application languages (XML, Java, J2ME and JavaCard, Mobile Operating Systems).  
CO1: Understand the Map Reduce technique for solving Big Data problems  
CO2: Understand algorithms for Big Data by deciding on the apt Features set  
CO3: Apply algorithms for handling peta bytes of datasets  
CO4: Analyze main memory consumption for Big Data analytics  
CO5: Understand and analyze the usage of map reduce techniques for solving big data problems |
| 40 | 17MCA453 | SOFTWARE QUALITY MANAGEMENT | CO1: Understand the Software Quality through Hierarchical models.  
CO2: Design the quality software by SQA plan Reviews and Audits.  
CO3: Apply quality control through CASE tools.  
CO4: Understand different quality standards |
| 41 | 17MCA454 | Principles of User Interface Design | CO1: Use the new technologies that provide interactive devices and interfaces.  
CO2: Apply the process and evaluate UID.  
CO3: Understand Direct Manipulation and Virtual Environment  
CO4: Discuss the command, natural languages and issues in design for maintaining QoS.  
CO5: Persuade user documentations and information search. |
| 42 | 17MCA51 | OBJECT-ORIENTED MODELING AND DESIGN PATTERNS | CO1: Acquire knowledge of  
- Basic UML Concepts and terminologies  
- Life Cycle of Object oriented Development  
- Modeling Concepts  
CO2: Identify the basic principles of Software modeling and apply them in real world applications  
CO3: Produce conceptual models for solving operational problems in software and IT environment using UML  
CO4: Analyze the development of Object Oriented Software models in terms of  
- Static behaviour  
- Dynamic behaviour  
CO5: Evaluate and implement various Design patterns |
<p>| 43 | 17MCA52 | PROGRAMMING | CO1: Understand C# and client-server concepts using .Net |</p>
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<tr>
<th>#</th>
<th>Code</th>
<th>Course Title</th>
<th>Course Outline</th>
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| 44 | 17MCA53| MOBILE APPLICATIONS               | CO1: Illustrate effective user interfaces that leverage evolving mobile device capabilities  
CO2: Develop applications using software development kits (SDKs), frameworks and toolkits  
CO3: Establish various methods to integrate database and server-side technologies  
CO4: Design and develop open source software based mobile applications  
CO5: Build and deploy competent mobile development solutions |
| 45 | 17MCA56| SOFTWARE DESIGN LABORATORY        | CO1: Understand the fundamental principles of Object-Oriented analysis, design, development and programming  
CO2: Demonstrate and represent the UML model elements, to enable visual representation of the system being developed  
CO3: Implement object oriented design model with the help of modern tool, Rational software Architect  
CO4: Analyze and differentiate the static and dynamic behavior of the system for achieving the intended functionalities of the system  
CO5: Evaluate Various design patterns for applicability, reasonableness, and relation to other design criteria |
| 46 | 17MCA57| .NET LABORATORY                   | CO1: Understand C# and client-server concepts using .Net Framework Components  
CO2: Apply delegates, event and exception handling to incorporate with ASP, Win Form, ADO.NET  
CO3: Analyze the use of .Net Components depending on the problem statement  
CO4: Implement & develop a web based and Console based application with Database connectivity |
| 47 | 17MCA58| MINI PROJECT MOBILE APPLICATIONS   | Illustrate effective user interfaces that leverage evolving mobile device capabilities  
Develop applications using software development kits (SDKs), frameworks and toolkits  
Establish various methods to integrate database and server- |
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<tr>
<th>Page</th>
<th>Code</th>
<th>Course Title</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
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<tr>
<td>48</td>
<td>17MCA541</td>
<td>WEB 2.0 AND RICH INTERNET APPLICATIONS</td>
<td>Understand the rich internet concepts and applications.</td>
<td>Analyze the working of development models in web designing.</td>
<td>Illustrate appropriate component lifecycle techniques using frameworks.</td>
<td>Evaluate and implement state based systems using data models and data binding</td>
</tr>
<tr>
<td>49</td>
<td>17MCA542</td>
<td>CLOUD COMPUTING</td>
<td>Understand the cloud computing delivery model and the enabling technologies.</td>
<td>Understand the cloud computing platforms, key technology drivers and cloud programming/software environments</td>
<td>Identify the need for cloud computing model and compare various key enabling technologies.</td>
<td>Analyze and choose an appropriate programming environment for building cloud applications.</td>
</tr>
<tr>
<td>50</td>
<td>17MCA543</td>
<td>ARTIFICIAL INTELLIGENCE</td>
<td>Acquire knowledge of</td>
<td>- Uncertainty and Problem solving techniques</td>
<td>- Symbolic knowledge representation to specify domains</td>
<td>- Reasoning tasks of a situated software agent</td>
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<td>Comprehend on</td>
<td>- different logical systems for inference over formal domain representations</td>
<td>- trace on particular inference algorithm working on a given problem specification</td>
<td>- Apply and Analyse AI technique to any given concrete problem</td>
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<td>- Interpret and Implement non-trivial AI techniques in a relatively large system</td>
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<td>51</td>
<td>17MCA544</td>
<td>STORAGE AREA NETWORKS</td>
<td>Understand the fundamentals of storage and storage networking concepts</td>
<td>Analyze Network Attached and Storage Area Networks Requirements</td>
<td>Apply and Integrate SAN and NAS solutions for an enterprise requirements</td>
<td>Design a secured, scalable SAN / NAS enterprise solutions</td>
</tr>
</tbody>
</table>
| 52 | 17MCA551 | SOFTWARE DEFINED NETWORKS | CO1: Recognize the fundamentals and characteristics of Software Defined Networks  
CO2: Understand the basics of Software Defined Networks Operations and Data flow  
CO3: Discriminate different Software Defined Network Operations and Data Flow  
CO4: Analyse alternative definitions of Software Defined Networks  
CO5: Apply different Software Defined Network Operations in real world problem |
| 53 | 17MCA552 | INTERNET OF THINGS (IoT) | CO1: Understand constraints and opportunities of wireless and mobile networks for Internet of Things.  
CO2: Analyze the societal impact of IoT security events.  
CO3: Develop critical thinking skills.  
CO4: Analyze, design or develop parts of an Internet of Things solution and map it toward selected business model(s)  
CO5: Evaluate ethical and potential security issues related to the Internet of Things. |
| 54 | 17MCA553 | SERVICE ORIENTED ARCHITECTURES (SOA) | CO1: Describe about evolution, characteristics and services in SOA with SOA architecture, WSDL, SOAP and UDDI.  
CO2: Analyze the SOA Architectural style, SOA strategies, modeling web services.  
CO3: Design, implementing process of SOA in web service.  
CO4: Apply the SOA operational style for the web services. |
| 55 | 17MCA554 | SOFTWARE PROJECT MANAGEMENT | CO1: Understand the practices and methods for successful software project management  
CO2: Identify techniques for requirements, policies and decision making for effective resource management  
CO3: Apply the evaluation techniques for estimating cost, benefits, schedule and risk  
CO4: Devise a framework for software project management plan for activities, risk, monitoring and control  
CO5: Devise a framework to manage people |