GENERAL ENGINEERING

GE101 TECHNOLOGY MUSEUM LAB (0-0-2-1-1)

Materials and building blocks: Evolution of materials and basic tools: Wood, bone, stone, teracotta, bronze smeltering, ironsmeltering, glassblowing, plastics, silicon-based modern electronic tools, manufacturing tools, 3D printer etc., Power: Evolution of energy: Manpower, Animal-power, Coal, Steam engine, Petroleum, Heat engines, Windmills, electrical generators, electrical motors, Nuclear power, Solar power, Batteries etc., Food: Evolution of fire/heat generation: direct friction of firewood, matchbox, lighter, piezoelectric spark, LPG stove, electric heater, kerosene stove, coal oven, microwave oven; Evolution of food preservation technology: Ice, Refrigerator, chemical preservatives etc., Clothing: Evolution of cloathing-related technology: Yarn-making, rope making, charkha; Knitting; Weaving;Stitching: Manual sewing, Sewing machine; Washing: Manual washing, washing machine etc., Shelter: Evolution of shelter-related technology: Cave, Igloo, huts, mud house, houses, multi-storied building, lift, air-conditioning, lighting, heating, construction tools and equipment etc., Transportation: Evolution of transportation: Wheels, Bullock cart, chariot, ships, bicycle, car, motorcycle, aircrafts, trains, roads, railroads, bridges, tunnels, spacecrafts, steam engine etc., Communication: Evolution of communication technology: Microphones, speakers, Alexander Graham Bell's telephone, wireless, internet, mobile phones, camera, TV etc., Health and safety: Evolution of health and safety technology: Medicines, Surgical tools, X-Ray, CT, MRI, Ultrasound, ECG, EEG, Blood Pressure monitor, Glucometers, Helmet, life Jackets, stethoscope, bullet-proof jackets etc., Information and Education: Evolution of Information and Education technologies: Galileo's telescope, Microscope, Slide rules, logarithmic tables, Calculators, Computers, Smart phones, Internet, Printing technology, typewriters etc.

GE102 WORKSHOP PRACTICE (0-0-4-2-2)

General introduction: Introduction of various machines installed in workshop, safety practices and metrology, Manufacturing with Metallic Materials: Fitting, Foundry and Carpentry, Metal Cutting, Metal Forming, CNC Programming & EDM, Welding, Manufacturing with Non-Metallic Materials: Extrusion and injection moulding process for polymers, various layup techniques for composites.

GE103 INTRODUCTION TO COMPUTING & DATA STRUCTURES (3-0-3-15/2-4.5)

Programming Methodology- Learning basic general purpose programming language, Basic Data Structures- Data structure: Trees, Stacks, Queues, Basic Algorithm Design and Analysis- Basic Algorithm Design and Analysis: Asymptotic notation and Sorting Algorithms.

GE104 INTRODUCTION TO ELECTRICAL ENGINEERING (2-2/3-2-13/3-3)

DC circuits and transients-Network terminology and types of energy sources, Mesh analysis, Node analysis, charging and discharging a capacitor, time constant and transient curve of RC circuit, Current growth and decay in LR circuit, time constant, transient curve of RL circuit, Study of DC transient on series RLC circuit. Single phase AC circuits, network theorms-Phasor representation of alternating quanities, phasor diagram, series RL and RC circuits, Series RLC circuit, Power in 1-phase AC circuit, Power measurement, superposition theorem, Thevinin and Norton theorm, Maximum power transfer theorem. Three phase AC circuits and magnetically coupled circuits-generation of 3

phase voltages, Star and delta connections, Power in 3-phase system, Power measurement in 3 phase system—two wattmeter method. Concept of self and mutual inductance and dot convention, Eddy and hysteresis losses, B-H loop. Transformers and Basic Machines- Ideal transformer, Practical transformer, Testing of transformer and finding parameters, introduction to Electrical machines, more on machine basics, DC shunt, seires machines.

GE105 ENGINEERING DRAWING (0-0-3-1.5-1.5)

Introduction: Elements and theories, orthographic Projection, Lettering and dimensioning, Points and Lines, Surfaces and Solids, Isometric Projection, Section of solid, Development of surfaces

GE106 MATERIALS SCIENCE FOR ELECTRICAL AND ELECTRONICS ENGINEERS (3-1-0-5-3)

Introduction, Conductors, Dielectrics and Insulators, Semiconductors, Nano Materials.

GE107 TINKERING LAB (0-0-3-3/2-1.5)

Computing components: Programming of microcontrollers (specifically Arduino board) for basic input, output, data processing and interfacing with a desktop computer or smart phone. **Electrical and electronic components Sensors**: for temperature, pressure, acceleration, pH, light etc. and its interfacing with microcontrollers. Electrical motors and solenoids, and their interfacing with a microcontroller.IR / RF remote controlling will also be introduced. **Mechanical components:** Fabrication of structural and kinematic components (such as gears, propellers, wheels etc.) through CAD modelling, STL file creation and 3D Printing.

GE108 BASIC ELECTRONICS 2-2/3-2-13/3-3

Diodes: Overview of Semiconductors, construction of PN junction diode, it's V-I characteristics. Diode applications: HW and FW rectifiers along with filters. Introduction to light emitting diode (LED) and photodiode. Study of Zener diode and application as a voltage regulator.

Bipolar Transistors: Introduction to BJT and introductory study of BJT construction. Study of Quiescent point analysis. Applications of BJT.

OperationalAMPLIFIERS: Introduction to Op-amp, Inverting and non-inverting configuration, Applications – adder, subtractor, integrator, differentiator and comparator, practical op -amps.

OSCILLATORS: Oscillators – Criterion for Oscillation, type of oscillators: Hartley oscillator, Colpitts Oscillator & RC Phase shift oscillator. DIGITAL ELECTRONICS: Binary arithmetic and Boolean algebra.Study of logic gates and its applications.

GE109 INTRODUCTION TO ENGINEERING PRODUCTS (0-0-2-1-1)

Study of technology of common household products: the following products and their components will be extensively studies with respect to their design, structure, function, materials, applied science, technology, economics, safety, environmental impact, social impact, current and future trends/innovation etc:3D Printer, Diesel Engine, Refrigerator, Washing Machine, Air Conditioner, Motorcycle, Mobile Phone, Automatic Blood Pressure Monitor, Desktop Computer, Microwave Oven, Sewing Machine, Bicycle / Manual Rickshaw, Laser Printer, Television.

GE201 INTRODUCTION TO MATERIALS SCIENCE AND ENGINEERING (3-1-0-5-3)

Introduction (Background & History): Historical perspective, Classification of Engineering materials, Structure-Property relationship, Structure of atom, Atomic bonding, Binding energy and Interatomic spacing, Unit Cell, The Space Lattices, Crystal Directions and Planes, Amorphous and Crystalline structure; Bragg's law, Structure determination using XRD, Point defects - Vacancies, Interstitials and Substitutional, Tetrahedral and Octahedral voids, Solid-solution, Hume-Rothery rules, Frenkel and Schottky defects; Edge and Screw dislocations, Burgers vectors, Motion of dislocations; Grain boundary, Twin boundary, Stacking faults, Fick's Laws of Diffusion, Steady-state diffusion, Nonsteady-state diffusion, Factors influencing diffusion, Phase rule; Single component systems, Binary phase diagrams, Microstructural changes during cooling, Tie-line, Lever rule; Eutectioc-Peritectic- Eutectoid-Peritectoid reactions; Fe-C phase diagrams; Applications of phase diagrams,

Process of Solidification, Nucleation and Growth, Homogeneous and Heterogeneous nucleation, Nucleation Kinetics, Growth and Overall transformation kinetics, TTT-Isothermal transformation Diagrams, CCT, Phase transformation for Fe-C alloys – Pearlite, Bainite, Martensite, Influence of alloying element; Precipitation process, Glass transition, Mechanical Properties: Stress and Strain, Elastic and Plastic deformation, Tensile, Hardness, and Impact Testing; Design/Safety factors; Slip systems, Mechanisms of strengthening in metals, Strain Hardening, Cold working, Annealing, Recovery-Recrystallization-Grain Growth, Ductile fracture, Brittle fracture, Fracture mechanisms, Methods of protection against fracture; S-N curve, Factors affecting Fatigue life; Mechanism of Creep, Creep resistant materials, Polymers, Ceramic, Composites: Synthesis, Properties and Processing, Consolidation theory of metal powders, Sintering theory and practices, Powder metallurgy materials, Design of powder metallurgy processes and parts, Electrical conductivity, Band structure of Solids (Metals, Semiconductor, Insulators), Single Crystal Growth using Czochralski method, Photolithography; Relationship between Absorption and Bandgap, Luminescence-Fluorescence- Phosphorescence; Classification of magnetic materials and basic concepts, Diamagnetic-Paramagnetic-Ferromagnetic-Superparamagnetic materials, Metallic and Ceramic magnetic materials, Electrochemical consideration, Types of corrosion, Protection against corrosion; Mechanism of oxidation, Oxidation resistant materials, Materials life cycle assessment, Recycling issues of various materials (Metals, Glass, Plastic and Rubber, Composite materials)

GE-203 MATERIAL SCIENCE FOR CIVIL ENGINEERS (3-1-0-5-3)

Introduction:- Introduction (Background & History): Historical perspective. From nano to macro a multiscale nature of materials. Classification of engineering materials. Advanced engineering materials. **Atomic Structure:-** Structure of atom, atomic bonding, binding energy, secondary bonding or van der Waals bonding, molecules.

Structure of Crystalline Materials:- Unit Cell, crystal lattice, metallic crystal structures, Bravais lattice, crystal plane, Miller indices, Bragg's law, mono-crystals, poly-crystals, crystal structure determination using XRD. Noncrystalline solid. **Defects in Crystals:-** Overview of defects in crystals such as point defects, line defects, interfacial defects, volume defects. A brief introduction to dislocation theory edge dislocation and screw dislocation. **Polymers:-** Polymer Structures, The Chemistry of Polymer Molecules, Molecular Shape, Molecular Structure, Thermoplastic and Thermosetting Polymers, Polymer Crystallinity, Defects in Polymers. **Mechanical Properties of Materials:-** Stress and strain response, elastic deformation, plastic deformation. Characterization of material response under tension, compression, and shear. Overview of material failure: fracture, fatigue, creep. **Materials used in civil engineering:-** Introduction to building materials. Concrete, ferrous metal, non-ferrous metal, wood, polymers, composites. Overview of their physical properties, mechanical properties, their characteristic behaviour under external stress.

Materials for Making Concrete:- 1. Cement: chemical composition, cement types, cement classification, and cement manufacturing. **2.** Aggregates: classification, characterization, properties, material testing. **3.** Water: quality of mixing water, water for washing aggregates, curing water. **Concrete:-** Composition of concrete, concrete chemistry, production of concrete, physical properties of green and hardened concrete, proportioning concrete mixes, factors affecting the properties of concrete, curing of concrete, concrete admixtures, destructive and non-destructive tests for concrete. **Special Cements and Cement Concretes:-** Acid-resistant Cements, Reinforced Cement Concrete, Prestressed Concrete, Polymer Concrete, Fibre Reinforced Concrete, Light Weight Concrete, High Strength Concrete, Ready Mixed Concrete, Self-compacting Concrete, High-performance Concrete, and Shotcrete. **Building Mortars:-** Classification, Characteristics of Good Mortar, Functions of Ingredients, Selection of Mortar, Testing.

Ferrous Metals:- Structures of ferrous metal, Types of gerrous metal, steel. Hot rolled and vold

formed sections, Reinforcing steel bars, rusting and corrosion, testing of steel sections, alloy steel, stainless Steel.

Non-Ferrous Metals:- Aluminum, Copper, Zinc, Lead, Tin, Nickel. **Advanced Composites in Civil Engineering:-** Polymer composites, textile composites, fiber reinforced composites, wood-polymer composites, sandwich composites. Overview of mechanical properties and testing of composites. **Structural Clay Products:-** Clay and its Classifications, Physical Properties of Clays, Bricks, Different Forms of Bricks, Testing of Bricks, Defects in Bricks. **Tar, Bitumen and Asphalt:-** Introduction, Bitumen, Tar, Pitch, Asphalt, General Properties, Testing. **Miscellaneous Materials:-** Heat Insulating Materials, Sound Insulating Materials, Water Proofing Materials, Geosynthetics, Smart Materials. **Sustainable materials:-** Introduction to sustainability. Materials life cycle assessment, Recycling issues of various materials (Metals, Glass, Plastic and Rubber, Composite materials)

CENTER FOR BIOMEDICAL ENGINEERING (CBME)

BM101 BIOLOGY FOR ENGINEERS (3-1-0-5-3)

Modern biology: An interdisciplinary approach, Cellular architecture: Prokaryotes vs. eukaryotes. Internal organisation of Eukaryotic cell -I. Internal organisation of Eukaryotic cell - II, III, IV. The chemistry of cell - Bio molecules. The chemistry of cell - Bio molecules, Bioenergetics. Origin and organisation of life. Cell division: Replication, mitosis and meiosis. Decoding of the genome: Transcription, Translation and basics of gene regulation. basics of gene regulation, Cell signalling: Inter cellular. Cell signalling: Intracellular. Molecular basis of disease. Fundamentals of genetic engineering: Concepts. Fundamentals of genetic engineering: Applications. Introduction to experimental biology - Cell based. Introduction to experimental biology – Molecular based.

BM451 FUNDAMENTALS OF BIOLOGY FOR ENGINEERS (3-0-2-7-4)

Theory: Modern biology: An interdisciplinary approach, Cellular architecture: Prokaryotes vs. eukaryotes. Internal organisation of Eukaryotic cell -I. Internal organisation of Eukaryotic cell - II, III, IV. The chemistry of cell - Bio molecules. The chemistry of cell - Bio molecules, Bioenergetics. Origin and organisation of life. Cell division: Replication, mitosis and meiosis. Decoding of the genome: Transcription, Translation and basics of gene regulation. basics of gene regulation, Cell signalling: Inter cellular. Cell signalling: Intracellular. Molecular basis of disease. Fundamentals of genetic engineering: Concepts. Fundamentals of genetic engineering:

- Applications. Introduction to experimental biology - Cell based.
- Introduction to experimental biology – Molecular approach.

Lab: Introduction to safe laboratory practices. Handling of biological materials. Working in a sterile/aseptic environment. Documentation of experiments (record/lab book). Mammalian cell culture: Observe the morphology under microscope, cell counting and subculture techniques. Isolation of proteins from cells. Quantitation of proteins by Bradford method, generation of standard curve and unknown analysis. SDS-PAGE analysis of proteins - staining for visualization. Basic microbiology methods: Preparation of culture media (liquid and solid), Plating and spreading methods. Molecular biology: Transformation of plasmid DNA into competent bacterial cells. Selection of clones. Isolation of plasmid DNA. Polymerase chain reaction (PCR). Agarose gel electrophoresis. Documentation.

DEPARTMENT OF CHEMICAL ENGINEERING

CH101 INTRODUCTION TO CHEMICAL ENGINEERING (3-1-0-5-3)

Introduction to Chemical Engineering, Production unit & Function, Thermodynamics, Chemical process, Control volume and concept of macroscopic balances, Catalysis, & Interphase contacting, Transport process in physical changes, Chemical reactors, Controllers, Process Economics, Applications of chemical engineering.

CH201 CHEMICAL ENGINEERING THERMODYNAMICS (3-1-0-5-3)

Introductory Concepts of Thermodynamic Systems and variables, Work, Heat, Internal Energy, State variables, First Law: Closed and Open Systems, Steady and Transient Flow Processes , Second law and Entropy; Entropy balance and availability, Isentropic processes, Ideal and non-ideal gases (pure component), Partial derivatives of thermodynamic properties, Maxwell Relations , Equations of State, Departure functions and pure component properties estimation using cubic EOS, Principle of corresponding states and generalized compressibility correlations/charts

Ideal and non-ideal mixtures; Partial molar quantities; Fugacity coefficient; generalized Gibbs-Duhem equation; Modelling of non-ideal gas and liquid mixtures using EOS and mixing rules; Property estimation of mixtures using EOS, Criteria for Thermodynamic Equilibrium; Phase Equilibrium Criteria, Pure Component Phase Equilibria, Vapour-Liquid Equilibria (VLE) for ideal mixtures ;Raoult's Law; Henry's law; Isothermal and adiabatic flash computation for ideal mixtures; Non-ideal Mixtures; Excess Properties; Activity coefficients; Modelling non-ideal liquid mixtures using activity coefficient models; VLE for non-ideal mixtures using activity coefficient models and EOS; Isothermal and adiabatic flash computations for non-ideal mixtures; Liquid-liquid equilibrium (LLE), Fluid-solid equilibrium , Homogenous Chemical Reaction Equilibrium: Single reaction; Multiple reactions, Combined phase and chemical equilibrium

CH202 TRANSPORT PHENOMENA (3-1-0-5-3)

Momentum transfer: Introduction to fluids

Introduction to rate of heat transfer, diffusion, and by analogy to momentum transfer, Molecular mechanisms in gases of transfer, Transport coefficients, Basic ideas about non -Newtonian fluids and binary diffusion processes. ,Description of flows, field approach, Euler acceleration formula, streamlines, streaklines, etc.; Reynolds' transport theorem, Conservation of mass, integral and differential; stream function, Linear Momentum balance, Newton's second law of motion, shell balances asapplied to 1-D flows, Navier-Stokes (NS) equations: applications: Poiseuille flow, Couette flow; unsteady and Stokes flow over a sphere/cylinder as examples of more complex flows, Non-Dimensionalization of equations and physical significance of, dimensionless groups.Energy equation- Mechanical energy & Bernoulli equations, some applications, High *Re* flow: Prandtl's approximation, basic inviscid flow, need for boundary Layer, Magnus effect (mathematical derivations be avoided), Boundary layers-elementary results for flat plates, Separation, flow past immersedbodies (bluff, streamlined); physics of ball-games (qualitative), **Heat transfer:** Conduction equation, non-dimensionalization, various approximations, Steady state conduction-concept of resistances in series and of critical thickness ofinsulation, Unsteady conduction: significance of Biot and Fourier numbers, Heissler charts, Low *Bi* case, penetration depth, Basic nature of convection: transpiration cooling, writing energy equation

without dissipation and pressure terms, one example (heat transfer to fluid flowing in atube); non-dimensionalization, Nusselt number and correlations, **Mass transfer**, Simple ideas of mass transfer, definitions (mass basis), similarity with heattransfer; use of steady 'conduction' concepts to solve simple steady cases in dilutesolutions as well as in stationary solids, boundary conditions Species Continuity equation: examples of binary diffusion with and without achemical reaction, One example involving all three transport phenomena should be discussed

CH203 HEAT AND MASS TRANSFER (3-1-0-5-3)

Heat conduction: Fourier law, thermal conductivity in gases, liquids and solids and their estimation, Molecular diffusion: Composition measures, velocities and fluxes, Fick's , law, mass diffusivity in gases, liquids and solids and their estimation , Steady state conduction in stagnant fluids and solids, fins, definition of heat transfer coefficients

Steady state diffusion in stagnant fluids and solids, definitions of mass transfer coefficients, their interrelationships. Coefficients for low and high fluxes, Differential energy balance equation, dimensionless form , Differential species balance equation, dimensionless form, , Unsteady heat conduction in stagnant fluids and solids. Heisler charts, numerical solution, etc., Unsteady diffusion in stagnant fluids and solids, Heisler charts, numerical solution etc.

Convective heat transfer (laminar): heat transfer in ducts, flat plate, falling film, natural convection, correlations

Convective mass transfer (laminar): mass transfer in ducts, over, flat plate, falling film, convection, Matlab, etc., correlations , Convective heat transfer (turbulent): heat transfer in ducts, flat plate and correlations, analogies

Convective mass transfer (turbulent): mass transfer in ducts, flat plate and correlations and analogies, simultaneous heat and mass transfer, wet-bulb and adiabatic saturation, Interface mass transfer, Boiling: pool and convective boiling, correlations, Condensation: film-wise and drop-wise condensation, correlations, Radiation: thermal radiation, radiation properties, view factors, Heat exchange between surfaces, Heat exchanger design: Shell-and-tube, compact exchangers, Reboiler, and condenser, Evaporators: type of equipment, single and multiple effect, Evaporators, Crystallization: phase equilibria, crystal growth, types of equipment, design.

CH204 FLUID MECHANICS (3-1-0-5-3)

Importance of fluid mechanics in Chemical Engineering applications, units and dimensions, Definition of fluid, viscosity and other physical properties, non-Newtonian fluids, Velocity, rate of deformation tensor, stress tensor

Dimensional analysis (Buckingham theorem), examples, Classification of flows (laminar/turbulent;

incompressible/compressible); Method of analysis; dimensionality and directionality of flow; steady/unsteady flows

Fluid statics; pressure measurement; forces on submerged surfaces, Integral and differential balances: conservation of mass and stream function, Integral momentum balances; calculation of forces, Shell balances for momentum; Flow in a pipe, annulus, in plane slit, Integral energy balance; Engineering Bernoulli equation; flow measurement devices (orifice, venturi, Pitot tube, rotameter, non-invasive methods), Energy loss in pipe flows, minor fitting losses

Pumps and compressors, Boundary layer flow over a plate; flow past a sphere; drag correlations, Flow in packed and fluidized beds; sedimentation, centrifugal separation, filtration, Mixing and Agitation:Power consumption; mixing times; scale-up., Introduction to turbulence and its consequences on flow in tubes, Introduction to compressible flows, Complex flows: fundamentals of two-phase (gas-liquid; liquid-liquid; slurry) flow, Particulate processes:

examples, characterization of particle size & shape), bulk behavior.

CH230 CHEMICAL ENGINEERING SIMULATIONS (0-0-4-2-2)

Technical Computing in ChE: Basics of Technical Computing, Technical Computing in ChE:Overview of Technical Computing Language to be used in Weeks 2-9, Technical Computing in ChE: Linear Systems , Technical Computing in ChE: Interpolation and Regression, Technical Computing in ChE:Data Visualization, Technical Computing in ChE:Numerical Differentiation, Technical Computing in ChE:Numerical Integration, Technical Computing in ChE: Non-linear equations, Technical Computing in ChE: Ordinary Differential Equations, Process Simulation in ChE:, Introduction to Process Simulation, Process Simulation in ChE: Introduction to Simulation Unit Processes and Operations, Process Simulation in ChE: Simulation of flowsheet, Process Simulation in ChE: Lecture on physical property methods and Project Work, Project Work

CH301 SEPARATION PROCESSESM (3-1-0-5-3)

Fundamentals of mass transfer:Concept of equilibrium, driving forces, and approach to equilibriumin mass transfer operations, Rate of mass transfer, mass transfer coefficients, Classification of separation processes,

Stage wise separations:Mass balance for an equilibrium stage, binary vapor-liquid equilibrium diagrams, Raoults law and relative volatility, Classification of types of non-idealities, **Distillation** : Flash distillation, Batch distillation, Steam distillation, Principles of continuous distillation, reflux ratio, **Continuous distillation:** Distillation column as a sequence of equilibrium stages, Mass balancesfor a sequence of stages, and operating lines, Quality of feed, Optimal location of feed Stage, Reboiler, Condenser, Calculation of number of equilibrium stages for a single feed, Modifications for multiple feeds.Energy balance and Ponchon-Savaritt diagram, Height equivalent of a theoretical stage,Height of a distillation column, Efficiency of a real stage. Types of distillation columns, Principles of design of distillation columns, Tray hydraulics, Gas velocities, Operation of distillation columns, **Liquid-liquid extraction:** Liquid-liquid extraction equilibria, Triangular diagrams,, Tie lines, Mass balance for a single equilibrium stage, Multistage extraction columns, Counter current contacting, Mass balances for a sequence of stages, Calculation of number of equilibrium stages, Mixer-settlers., **Continuous contacting:** Column contactors, Packings, Gas-liquid equilbria. Absorption/desorption column Differentialmass balance for absorption/stripping, Equilibrium and operating lines, Theoretical stage analysis and similitude to distillation, Determination of NTU, and HTU, Absorption/desorption column hydraulics, and design, **Extraction columns:** Types extraction columns, Hydrodynamics of extraction columns, Mass transfer problems in extraction columns, Problems of phase separation, Analysis of dispersed phase extraction columns. Process intensification, Centrifugal methods, Reactive distillation Simultaneous heat and mass transfer Review film model analysis, Psychrometric Charts, Wet and dry bulb temperatures, Analysis and design of humidification and cooling towers, Drying curve, Analysis of tray dryers Membrane separations, Ion exchange, and adsorption, Pressure swing adsorption, Chromatography and Electrophoresis

CH302 CHEMICAL REACTION ENGINEERING (CRE) (3-1-0-5-3)

Chemical kinetics, phenomenology, stoichiometric matrix and independent reactions; Bounds for real reactor performance by ideal reactors; Mass balances for batch, well mixed, and plug flow reactors for elementary reactions and comparison of reactor volumes for ideal reactors; Multiple reactions: equilibrium step and pseudo steady state approximation, yield and selectivity, response of ideal reactors; Theories of

reaction rates; Energy balance for non-isothermal reactors, multiple steady states; experimental determination of kinetics parameters; RTD; Non-catalytic fluid-solid reactions; Kinetics of heterogeneous catalytic reactions; Diffusion effects in catalysis; Modeling of a non-isothermal packed bed reactor with axial dispersion coefficient and effectiveness factor.

CH303 PROCESS CONTROL (3-1-0-5-3)

Introduction, Process Modeling, Laplace Transform, Frequency Response, Disturbance and Stability, Controllers, Routh Table Controller Tuning - Stability Based and Performance Based Stability Analysis, Model Predictive Control (MPC).

CH304 PROCESS EQUIPMENT DESIGN (3-1-0-5-3)

Discuss with different groups on design of heat transfer equipment, Presentation of design and report submission

Discuss with different groups on design of mass transfer equipment, Presentation of design and report submission,

First quiz on heat and mass transfer equipment designs, Discuss with different groups on design of fluid flow equipment, Presentation of design and report submission, Discuss with different groups on design of reactors, Presentation of design and report submission, Second Quiz on fluid flow and reactor equipment designs, Process Safety and HAZOP Plant commissioning and Ethics

CH305 PROCESS DESIGN AND ECONOMICS (3-1-0-5-3)

Process Economics : Introduction to different aspects of design (plant design, equipment design, process design) and the importance of process design Process Economics - *Cash Flows*, Breakdown of total capital investment into different costs, Project and equipment cost estimation (scaling laws, factor method) Sales revenue, manufacturing costs, profits**,** **Depreciation and taxes, Process Economics** – *Profitability Analysis*, Profitability Analysis (return on investment, payback period, net present value, internal rate of return, capitalized cost, annualized cost). Choosing between alternatives**, Conceptual Process Synthesis:** General process flowsheet structure, Hierarchy of flowsheet structures Systematic generation of input-output and recycle structures, **Reactor Network Synthesis:** Types of reaction systems (choice of reactor, temperature, pressure, relative concentration of reactants, addition of inerts),Use of attainable region for reactor network synthesis, **Separation System Synthesis:** Choice of separation method,Determining ideal and non-ideal mixture behavior using infinite, dilution activity coefficients and infinite dilution equilibrium constants, Distillation column sequencing for ideal mixtures, Separation system synthesis for heterogeneous azeotropic mixtures, Residue curve maps and its use in separation system synthesis for homogeneous azeotropic mixtures,**Heat Exchanger Network Synthesis:** Introduction and problem statement for heat exchanger network synthesis, Minimum energy targets using temperature interval analysis, Cascade diagram, pinch definition, source sink diagram and pinch design rules, Heat exchanger network design for maximum energy recovery using pinch design rules, grid diagram representation of HEN design, Minimum exchanger target, paths and loops, evolutionary synthesis for trade-off between energy and capital, Composite diagram, Heat Exchanger Network (HEN) area target, optimum minimum approach temperature, Grand composite curve and external utility distribution, Heat and power integration, integration with distillation columns, Retrofitting existing HENs

CH120 SEMINAR I (0-0-2-1-1)

CH220 SEMINAR II (0-0-2-1-1)

CH320 SEMINAR II (0-0-2-1-1)

DEPARTMENT OF CHEMISTRY

CY101 CHEMISTRY FOR ENGINEERS (3-1-2-6-4)

Role of chemistry in engineering applications : Introduction; Chemical Kinetics, Chemical Kinetics, Thermodynamics , Thermodynamics, Electrochemistnry, Fuel and combustion, Catalysis, Enzyme catalysis, Errors, standard deviation and data analysis, Separation Techniques, Organic chemistry, Organic chemistry, Polymer Chemistry Organometallics Theory of origin of colour Desalination.

CY230 INTRODUCTION TO ORGANIC CHEMISTRY AND BIOCHEMISTRY (3-1-0-5-3) Structure-activity relationships in simple organic molecules; Oxidation: Cr and Mn compounds, peracids, and other peroxides; Reduction: metal hydride, dissolving metal, and hydrazine-based reductions. Cram-Felkin-Anh model; Strategies for C-C bond formation: acyloin, aldol, Cannizzaro, Claisen, Knoevenagel, and benzoin condensations; Carbohydrates: introduction and typical reactions of monosaccharide; Amino acids and peptides: physical properties of amino acids and synthesis of α-amino acids; Role of water and buffers in biological systems; Structure and function of biomolecules- carbohydrates, lipids, nucleic acids, and proteins; Enzyme kinetics (including single molecule enzyme kinetics); Membrane transport and cell signaling; DNA as a hereditary material and genetic engineering; Viruses (including HIV-1 infection); and Common metabolic pathways

DEPARTMENT OF CIVIL ENGINEERING

CE201 STRENGTH OF MATERIALS (2-1-2-4-3) **Introduction to deformable bodies:-** Motivation, aim, and expected outcome. Introduction to structural systems. Types of materials and their responses. Overview of 2-D and 3-D structural elements. Introduction to mechanical testing of materials. Need for mathematical models. **Review of matrix algebra :-** A brief introduction to indicial notations, scalar, vector, dot product, cross product, tensors, matrix addition, multiplication, characteristic equation, eigenvalues and eigen vectors. **Kinematics of deformable bodies:-** 1-D Definition of strain, and introduction to various strain measures), Concepts of large and small deformation. Deformation mapping and deformation gradient. Generalized definition of strain for 3-D bodies, strain-displacement relationships, and compatibility conditions. Principle strains in 3D. 2-D Mohr's circle. **Analysis of stresses: -** Definition of stresses. Various stress measures. 1D definition of stress. Concept of stress-vector and stress-tensor. Cauchy relation. Stress resultants. Principle stresses in 2D and 3D.Equivalent force systems.

Constitutive Relations:- Types of material and material responses. Concept of isotropy, orthotropy, anisotropy etc. Generalized Hooke's law. Concept of plane strain and plane stress problems. **Balance laws in solid mechanics :-** Force balance or equilibrium equations.Derivation of equilibrium equations by using strength of materials approach in Cartesian coordinate system. Theorem of virtual displacement and its application in deriving the equilibrium equations. **Pure bending of beams:-** Concept of shear force and bending moment diagrams. Moment curvature relationship. Euler Bernoulli beam theory. Macaulay's method for solving beams under transverse load. **Energy method :-** Strain energy and complementary strain

energy. Virtual work theorem revisited. Castigliano's theorem. Maxwell-Betti theorem. Theorem of minimum potential energy.**Buckling of rods:-** Concept of buckling. Derivation of governing equations. Solving column buckling problems. **Torsion of members:-** Torsion of thin and thick-walled members. Derivation of St Venant's theory for torsion of member. Calculation of shear centre for thin-walled members. **Course project:** Construct a prototype wooden tower with the given materials that can sustain the maximum load before collapse.

CE202 FUNDAMENTALS OF FLUID MECHANICS (2-2/3-0-10/3-2)

Properties of Fluid:- Physical properties of fluids, Newton's Law of Viscosity, dynamic and kinematic viscosity, classification of fluids, Newtonian and Non Newtonian fluids, ideal and real fluids, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure**, Fluid Statics:-** The basic equation of hydrostatics, concept of pressure head, Measurement of pressure (absolute, gauge), Application of the basic equation of hydrostatics. Piezometers, simple and differential manometers, inclined manometers, total pressure force and, center of pressure for plane and curved surfaces, Practical applications (gate, dams, lock gates)**, Buoyancy and Floatation:-** Principle of floatation and buoyancy, Equilibrium of floating bodies, Stability of Floating bodies, metacentre, metacentric height, Stability of submerged bodies.**, Fluid Kinematics:-** Velocity and acceleration of fluids, local and advective acceleration, types of flow: steady and unsteady, uniform and nonuniform, laminar and turbulent, rotational and irrotational, circulation and vorticity. Equations of streamline and equipotential lines, flownets for one dimensional . **Fluid Dynamics :-** Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration, Assumptions of Bernoulli's equation, Kinetic energy correction factor, Hydraulic Grade line and total energy line, Introduction to Navier- Stokes equations, Linear momentum equation and momentum correction factor, angular momentum, Application of continuity, Bernoulli and momentum equations. Flow through orifices and mouthpieces under free and submerged condition, Discharge/velocity measurement: Pitot tube, Venturimeter, orificemeter Laminar and Turbulent flow: Basic definitions, Reynolds Experiment, Stoke's law, Methods of measurement of viscosity, Transition from laminar to turbulent flow, Basic features of turbulent flow, Prandtl's mixing length theory**, Dimensional analysis and physical model studies:-** Dimensions of physical quantities, Dimensional homogeneity, Dimensional analysis using Bukingham's Pai theorem, important dimensionless parameters and their significance. Geometric; Kinematic and Dynamic similitude; Model laws, Type of models, Applications of dimensional analysis and studies to fluid flow problems. **Boundary layer theory:-** Development of boundary layer on a flat plate, Nominal, displacement, momentum and Energy thicknesses. Laminar, turbulent and transitional boundary layer, Application of momentum equation for boundary layer development, Local and mean drag coefficient, Hydro dynamically smooth and rough boundaries, Boundary layer separation and its control.

CE301 STRUCTURAL ANALYSIS I (2-2/3-0-10/3-2)

Statically Determinate Structures:- Determination of forces in trusses, beams and frames; bending moment, shear force and axial force diagrams. **Deflection of Statically Determinate Structures:-** Deflection of beams and frames using principle of virtual work, Moment-area method, Conjugate-beam method; Energy Principles; Maxwell's and Betti's laws

Statically Indeterminate Structures:- Degree of static and kinematic indeterminacies for trusses, plane and space frames

Analysis of Statically Indeterminate Structures:- Concept of compatibility conditions; Analysis of indeterminate structures by flexibility method, consistent deformation method, strain energy method, influence coefficient method, Column analogy method. **Influence Line Diagram:-**

Concept of influence lines using equilibrium methods, Influence line diagram using Muller Breslau principle for statically determinate and indeterminate structures

CE302 PIPE AND OPEN CHANNEL HYDRAULICS (2-2/3-2-13/3-3)

Introduction:- Recapitulation of fluid mechanics concepts, introduction of hydraulic approach. **Flow through Pipes:-** Laminar flow, Turbulent flow, Frictional head loss, Losses in transitions and fittings, Concept of equivalent length, Applications of Continuity equation, Bernoulli's/Energy equations, Momentum equation, Dynamic forces on pipe transitions, Flow through various pipe-networks, Solution algorithms, Transient flow, governing equations, water hammer, surge tank, Hydraulic transmission of power through pipes. **Flow in Open Channels:-** Introduction to open channel flow, velocity and pressure distribution, rigid and mobile beds, uniform flow, critical flow, types of open channel flow, Specific Energy, Specific force, Hydraulic jump, Applications of Continuity equation, Bernoulli's/Energy equations and Momentum equation; Critical flow: critical depth, specific energy diagram, Computational of Critical depth, Channel hump, contraction and expansion; Uniform flow: Basic concepts, Manning's and other equations, Computation of normal depth, Compound sections, Design of open channels; Non-uniform flow: Gradually and rapidly varied flow, Governing equations of Gradually varied flow, Classification of gvf, Computation of gvf profiles, Direct step and Standard step methods, Numerical solutions

CE303 SOIL MECHANICS (2-2/3-2-13/3-3)

Engineering Geology:- Soil Formation and Composition, Soil Types, Regional Soil Deposits of India. **Soil Structure & Clay Minerology:-** Structure of Clay Minerals, Different Types of Clay Minerals, Soil Structure, **Index Properties and Soil Classifications:-** Phase Diagrams, Some Important Relationships, Water Content Determination, Specific Gravity of Soils, Index Properties of Soils, Grain Size Analysis, Consistency of Clay (Atterberg's Limits), Classification of Soils, **Effective Stress, Capillarity & Permeability:-** Effective Stress Principle, Capillary Rise of Water in Soils, Permeability of Soil, Darcy's law, Constant head & Falling head test, Factors affecting permeability, Permeability of Stratified Soils, Types of Head, Seepage and Quick Sand Condition, **Seepage Through Soil:-** Seepage forces, Flow Net, Graphical Methods for obtaining Flow Nets, Introduction to Filter design, **Vertical Stresses in Soil due to Applied Load:-** Stresses within the soil mass, Introduction to Boussinesq equations, Newmark's Chart, **Compaction:-** Theory of Compaction, Laboratory Tests, Factors affecting Compaction, Engineering Behaviour of Compacted Soils, Field Compaction, Machines used for Compaction

Consolidation:- Compaction characteristics, Components of Total Settlement, Compressibility, Void Ratio- Effective Stress Relationships, Mechanics of Consolidation, Terzaghi's Theory of Consolidation, Consolidation Tests, Computation of Settlement. **Shear Strength of Soil:-** Stress at a point: Mohr Circle of Stresses, Mohr Coulomb Failure Criterion, Measurement of Shear Strength: Direct Shear, Triaxial, UCS, Vane Shear, Tests

CE304 GEOMATICS (2-2/3-2-13/3-3)

Introduction to Geomatics:- History of Surveying and Mapping, Importance of Geomatics Engineering, Maps and Maps Numbering System. **Concept of Datum and Map Projection System:-** Coordinate System in Two and Three Dimensions, Datums, Geodetic Coordinate System, Coordinate Transformation, and Map Projection Systems. **Conventional Field Survey: -** Introduction to Conventional Surveying Instruments and their Working Principles. The concept of Distance and Angular Measurements in Surveying. Sources of Errors in Conventional Surveying. **Modern Field Survey Systems:-** Introduction and Development in the field of surveying. Working Principles of Instruments - Total Station, Global Positioning Systems, LASER based instruments. Sources of Error in the Measurements and their removal.

Space Technology for Surveying:- Remote Sensing and Photogrammetry - Fundamentals. Types of Photographs, Stereoscopy, Geometry of Photographs, Concept of Relief and Tilt Displacements, Digital Photogrammetry, Digital Image Processing. **Geographic Information System:-** Introduction to Geographic Information System, Types of Data, Generation of Database, Concepts of Digital Maps, Integration of Information and Analysis **Applications of Geomatics Engineering:-** Topographic Mapping, Digital elevation models, Deformation Studies, Engineering Surveys, Land Use and Land Cover Mapping.

FOR CONTINUING STUDENTS IN LTP STRUCTURE

CEL301 REINFORCED CONCRETE STRUCTURE (3-1-1) (4.5)

Materials for Reinforced Concrete: properties and testing of cement, water, fine and coarse aggregates, brief introduction to admixtures, **Properties of Reinforced Concrete:** Compressive strength, tensile strength, stress-strain behavior, modulus of elasticity, ductility, shrinkage, creep, characteristic strength, grades of concrete, design stress-strain curve of concrete; types and grades, stress-strain behavior, and design stress-strain curve of reinforcing steel, **Methods of Design of Reinforced Concrete Structures:** Working stress and limit state design methods; Concrete mix design procedures, **Design of R.C. Beams:** Singly and doubly reinforced rectangular/flanged sections, design for shear, bond and anchorage of reinforcement, limit states of deflection and cracking **Design of Slabs:** Design of one way slabs, two-way slabs **Design of R.C. Columns:** Design of axially loaded and eccentrically loaded compression members, effect of small and large eccentricities, **Design of Footings:** Foundation types, design of isolated footings, introduction to combined footings, **Concept of Earthquake Resistant Design (ERD):** Design philosophy and Material Behaviour under earthquake, Four virtues of ERD: Stiffness, Strength, ductility and Configurations, Introduction to Capacity design concepts, Introduction to IS:1893 and IS: 13920, Ductile Design and Detailing of Earthquake Resistant Structures

CEL302 WATER RESOURCES ENGINEERING (3-1-0) (4)

Introduction to Hydrology: Hydrological cycle; various hydrological processes; elementary concepts of precipitation, evaporation, transpiration, evapotranspiration and infiltration. **Streamflow Hydrographs**: Selection of site; various methods of discharge measurements; factors affecting runoff; rainfall-runoff relationships; runoff hydrograph; unit hydrograph theory; S-curve hydrograph; synthetic unit hydrograph; use of unit hydrograph; Floods-estimation of peak flow, rational formula and other methods, flood frequency analysis, Gumbel's method, Design floods. **Irrigation Engineering:** Necessity of irrigation; water requirement of crops; soil classification; soil moisture and crop water relationship, factors governing consumptive use of water, design of irrigation canals. **Reservoir Planning:** Types of developments: storage and diversion works; Purpose: single and multipurpose; investigation for locating reservoir; selection of site; dependability calculations; estimation of required storage; mass curves; reservoir sedimentation; flood routing; height of dam; reservoir operation; economics of reservoir planning, benefit-cost ratio
Ground Water Hydrology: Occurrence of subsurface water and groundwater; types of aquifers; aquifer parameters; steady state well hydraulics, pumping tests; groundwater resource estimation. **Water logging and drainage:** Causes of water logging; preventive and curative measures; drainage of irrigation of lands; reclamation of water logged, alkaline and saline lands; Lift irrigation schemes - various components and their design principles; Application of water- water management and distribution, warabandi

CEL303 STEEL STRUCTURES (3-1-0) (4)

Steel structures are widely used in Civil Engineering. Building frames, transmission towers, bridges, stadium roof, grid-shell structures etc. are some common examples of steel structures. This

course aims to provide the fundamentals of designing steel structures. In this course, the students will understand the philosophy of designing steel structure, will identify the action on structures, will be taught about the modes of failure in steel structures, and will also learn to perform safe, economic, efficient design of steel structures, structural steel members, and connections. The topics to be covered are as follows.

- Description of steel structures. Fabrication.
- Mechanical properties of structural steel. Types of material failure: yielding, brittle fracture, hot rolling, cold drawing, residual stresses.

- Instabilities in steel structure, Euler buckling, local buckling, distortional buckling, and coupled instabilities. Global and local P-delta effects.
- Design philosophy for steel structures. Action on structures. Types of structural steel members.
- Design of tension and compression members.
- Design of flexural members.
- Design of beam columns.
- Design of plate girders
- Structural fasteners: riveting, welding, and bolting. Properties and design of fasteners. Design of pinned connection, fixed connection, and partially fixed connection.
- Design of steel trusses, moment resisting frames, silos.

CEL451 FOUNDATION DESIGN (3-1-0) (4)

Soil Exploration: Different methods of Soil Exploration, Methods of Boring, Collection of Soil Samples, Field Tests: SPT, CPT, PMT, **Lateral Earth Pressure**: Earth pressure at rest, active and passive earth pressures, introduction to Rankine's earth pressures, Coulomb's lateral earth pressure theory, **Types of Foundation:** Introduction to foundation engineering, different types of foundation, Requirements of good foundation, **Bearing capacity of shallow foundations:** Failure mechanism, Terzaghi's bearing capacity equation, bearing capacity from field tests, Foundations subjected to eccentric and inclined loads. , **Foundation Settlement:** calculation, settlement problems, stress in soil mass, immediate settlement calculation, field plate load tests, **Design of shallow foundations:** Geotechnical and structural design of isolated footings, strip, rectangular and trapezoidal combined footings – strap – balanced footings , **Deep Foundations:** types of piles and their applications, single pile and pile group - load capacity – settlements, pile load test, negative skin friction, under reamed pile foundations, other deep foundations, **Stability of Slopes**: Infinite and Finite Slopes, Stability of infinite slopes, finite slopes, Analysis of finite slopes.

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CS101 DISCRETE MATHEMATICAL STRUCTURES (3) (3-1-0-5)

Sets, Relations, and Functions, Logic and Proofs, Mathematical Induction, Combinatorics, GraphTheory

CS201 DATA STRUCTURES (3-1-2-6-4)

Basic Data structures: Introduction to arrays, stacks, linked lists, queues, heaps**. Algorithm Analysis:** Tools and techniques required to analyse various algorithms and data structures, Asymptotic behaviour of time/space complexity, Asymptotic notations, Master Theorem, Amortised analysis**. Search Trees:** AVL Trees, Multi-way Trees, Red-Black Trees, Splay trees**. Sorting:** Lower bound on sorting, quick sort, linear time sorting, Medians and order statistics**. Hashing:** Dictionaries, Tries, Hashing, Various hash functions, Chaining, and Expected time analys, Analysis of collision resolution techniques, Skip Lists**. Graphs:** Definition of graphs, paths, trees, cycles. Data structures for graphs: adjacency lists, adjacency matrix, Depth First Search, Breadth First Search and their applications, Union-find data structure and

applications, Minimum Spanning Tree, Shortest path algorithms, Topological sort, Transitive closure

CS202 PROGRAMMING PARADIGMS AND PRAGMATICS (3-1-2-6-4)

Introduction: Motivation to study concepts of programming languages and introduction to major language families

Compiler Design: Introduction to Regular Expressions, Syntax Analysis, Lexical Analysis. Implementation using Lex/Yacc.

Foundations: Covers fundamental semantic issues of variables with emphasis on Names, Binding, Scope, Lifetime and Type Checking **, Core Design Constructs:** Covers issues that lie at the core of most programming languages: Data Types, Control Flow, Subroutines, Abstraction & Object Orientation**, Alternative Programming Models:** Introduction to Functional and Logic Programming Languages, **Concurrency:** Basic introduction to the fundamentals of Concurrency including communication, synchronization, creation and implementation of threads

CS203 DIGITAL LOGIC DESIGN (3-1-2-6-4)

Digital System: Introduction to digital logic and digital system, digital logic states, number systems**, Boolean algebra and logic minimization:** Boolean functions, expressions, minimizations of Boolean functions, K maps, QM method, two level and multiple level logic. **Combinational logic design:** Basic components: adder, multiplexer, decoder, ROMs, programmable logic, Introduction to HDL and FPGA. Arithmetic circuits. **Synchronous sequential logic design:** Flip-flops and latches, finite state machines – mealy and moore, state assignment and state minimizations. Counters, registers, and memories. **Top down approach of digital design:** Data path-control path design, register transfer level design, pipelining and parallelism. Case studies. **Advanced issues in digital design:** Parallelism, IP blocks and reuse, timing issues, faults and testing. **Technology aspects:** FPGA and ASICs, logic mapping and binding, introduction to logic synthesis and EDA tools.

CS204 COMPUTER ARCHITECTURE (3-1-2-6-4)

Introduction to computer architecture: Introduction to computer architecture, program performance, history and current state of the art. Stored program concept. **Machine level representation of programs:** Instruction set architecture, Assembly language, programmer's prospective, instruction encoding. Case studies. **Processor design:** Single cycle processor – data path and control path design, pipelined processor design, hazards, data forwarding and branch prediction. Exceptions and interrupts. **Memory organization:** Caches, main memory and virtual memory. Secondary storages. **Optimizing program performance:** Performance, role of compiler optimizations, architecture specific code optimizations, cache aware code optimizations**. System prospective:** Input/output devices, DMA, busses and interconnect system on chip, multi processors.

CS301 DATABASES (3-1-2-6-4)

Introduction to Relational Model: This module would introduce the students to basic concepts relating to the relational model of storing data. We would also cover formal relational query languages in this module. **Designing SQL queries:** This module would cover SQL query languages in depth. This module is the foremost and a fundamental part of this course, thus more time would be spent in this module.**Database Design:** This module would cover ER models and normalization theory of databases. This module is the second most important part of this course. **Introduction to Data Storage and Query Processing:** This module introduces basic concepts relating to file structures and query processing algorithms used in databases. Topics such as indexing structures (e.g., B+ trees), join processing algorithms would be covered. **Introduction to Transactions:** We would introduce basics of database transactions in this course. Topics like ACID properties, basic concurrency control techniques and recovery algorithms would be

covered in this module.**Topics in Parallel and Distributed Databases:** This module would introduce some advanced topics in databases relating to parallel and distributed databases such as quorum consensuses protocol.

CS302 ANALYSIS AND DESIGN OF ALGORITHMS (3-1-0-5-3)

Advanced data structures : Interval and range trees. Segment trees. Splay trees. Binomial heaps. Fibonacci heaps.

Divide and conquer : Master's theorem. Karatsuba integer multiplication algorithm. Mergesort. Strassen's matrix multiplication algorithm. Fast fourier transform and polynomial multiplication. Convex hull. Closest pair of points. Linear-time deterministic median algorithm. **Dynamic programming** : Shortest paths in directed acyclic graphs. Longest increasing subsequence. Knapsack problem. Edit distance. Matrix chain multiplication. Bellman-Ford and Floyd-Warshall algorithms. Independent set in trees. Optimal binary search trees. **Greedy algorithms** Minimum spanning trees. Union-Find data structure. Huffman coding. Horn satisfiability. Task scheduling problems.

Miscellaneous Topics:

i. *Number-theoretic algorithms:* Euclid's algorithm. Modular arithmetic. Primality testing. RSA algorithm.
ii. *String algorithms:* Knuth-Morris-Pratt algorithm, Rabin-Karp algorithm.
iii. *Linear programming:* Standard form. Duality. Simplex algorithm.
iv. *Randomized algorithms:* Universal hash functions and perfect hashing. Skip-lists. Karger's min-cut algorithm.
v. *Network flows:* Ford-Fulkerson algorithm. Bipartite matching

NP-completeness and approximate algorithms

Search and decision problems. NP and co-NP. NP-completeness reductions. Approximation algorithms. Traveling salesman problem. K-center. Set cover. Vertex cover. Knapsack problem.

CS303 OPERATING SYSTEMS (3-1-2-6-4)

Processes: Process concept, multithreading. **Scheduling:** How processes are scheduled on different kinds of hardware architectures. **Synchronization:** How processes access shared resources & synchronize while trying to access shared data. **Memory Management:** How various memory technologies are managed by the operating system. **File Systems:** File system implementation and management. **I/O:** Input/output implementation and management.

CS304 COMPUTER NETWORKS (3-1-2-6-4)

Introduction to networks: Introduction to Protocol Layering, TCP/IP architecture, Circuit Switching, Packet Switching, Access Networks, Physical Media, Roles of different layers. **Data link layer:** Address resolution protocol, Wireless LAN's, Error detection and correction, Retransmission, Multiple Access protocols (MAC): Aloha, CSMA/CD and CSMA/CA

Network layer: Routing versus forwarding, Routing in the Internet, Internet Protocol, multicast routing, routing for mobile hosts**. Transport layer:** TCP/IP, Connectionless Transport UDP, Principles of Reliable Data Transfer, Connection-oriented Transport TCP, Flow Control, and Congestion Control. **Application layer:** World Wide Web, File Transfer protocol, SMTP, Domain Name System, Socket Programming**. Network Security:** Security services, Attacks**. Wireless and Mobile Networks**: Addressing and routing to mobile users, cellular networks

CS305 SOFTWARE ENGINEERING (3-1-2-6-4)

Introduction: Overview of professional software development. **Software Processes:** Software Development Lifecycle (SDLC): Software process models and activities. **Modeling:** Requirements, Design concepts and modeling. **Design and Implementation:** Object-oriented design using the UML.Implementation issues and use of design patterns. **Software Testing:** Regression testing,

Integration testing, Test generation etc. **Software management:** Estimation techniques, Configuration management

CS 306 THEORY OF COMPUTATION (3-1-0-5-3)

Finite automata and regular expressions: Deterministic and nondeterministic finite automata. Equivalence of both models. Regular expressions. Kleene's theorem. Myhill-Nerode Theorem. Pumping lemma for regular languages. Closure properties.**Pushdown automata and context-free grammars:** Context-free grammars. Ambiguous grammars. Chomsky normal form. Pushdown automata. Equivalence of pushdown automata and context-free grammars. Pumping lemma for context-free languages. Closure properties. **Turing machines:** Turing machine. Church-Turing thesis. Equivalence of different computational models. Universal Turing machine. Recursive and recursively enumerable languages. Decidable problems about regular and context-free languages. **Undecidability:** Halting problem. Undecidable problems. Problems which are not recursively enumerable. Reductions. Rice's theorem. Undecidable problems about context-free grammars. **Time and space hierarchy:** Time and space complexity. Hierarchy theorems. **NP-completeness:** NP and co-NP. Cook-Levin theorem. NP-completeness reductions. **Advanced complexity theory:**Logarithmic space. Polynomial space. Randomized computation.

DEPARTMENT OF ELECTRICAL ENGINEERING

EE201 SIGNALS AND SYSTEMS (3-1-0-5-3):

Classification of signals and systems, various system representation techniques, differential, difference and state-space representations, Fourier transforms and series, application to analysis of systems, Laplace transform, its properties, and its application to system analysis, Sampling of continuous signals and sampling theorem, Z-transforms, its properties and applications, Random variables and random process, characterization of random variables and random process, linear systems and random signals.

EE203 DIGITAL CIRCUITS (3-1-0-5-3)

Introduction to binary arithmetic, Boolean algebra, K-maps and logic gates: Number base conversion, theorems on Boolean algebra, simplification of Boolean functions using K-maps, logic gates and their applications **Design of combinational circuits:** Design of basic combinational circuits including adders, subtractors, encoders, decoders, multiplexers/de-multiplexers, encoders/decoders, code convertors. **Design of sequential circuits:** Design of basic memory circuits (latch), flip-flops, counters, and shift registers. **Introduction to digital logic families:** Study of DTL, TTL, ECL, CMOS, BiCMOS logic families. **Data processing and conversion:** Sample and hold circuits, ADCs and DACs; Basic memory circuits ROM, RAM and PLA.

EE204 DIGITAL CIRCUITS LAB (0-0-3-3-1.5)

1. Implementation of digital logic using switching circuits.
2. Study of universal gates.
3. Design of a 1-bit Full Adder/Subtractor using logic gates.
4. Design and implementation of a 4-bit binary ripple adder using logic gates.
5. 4 X 3 bit binary multiplier using logic gates.
6. Review of lab projects
7. Mid semester exam
8. Study of code converters. (BCD to excess-3, binary to gray and gray to binary)
9. Study of combinational MSI circuits – 1-bit half/full adder, 1-bit half/full subtractor and 1-bit magnitude comparator.
10. Study of sequential circuits –Implementation of Flip-Flops
11. Design of a synchronous decade counter.

12. Design of 4-bit parallel input serial output (PISO) shift-register.
13. End semester exam
14. Final demonstration of lab projects

EE205 ELECTROMECHANICS (3-1-0-5-3)

Transformer and its applications, General features of polyphase AC machines, The polyphase induction machine

The polyphase synchronous machine, The single phase motor, The stepper motors, The DC machine

EE206 ELECTROMECHANICS LAB (0-0-3-1.5-1.5)

Transformer and its applications, General features of polyphase AC machines, The polyphase induction machine

The polyphase synchronous machine, The single phase motor, the stepper motors, the DC machine.

EE207 CONTROL ENGINEERING (3-1-0-5-3)

Mathematical basics for linear control systems, Feedback and its features, Common components for control engineering, Time response analysis in linear analog domain, Time response analysis in linear digital domain, Root-locus concepts in analog and digital domain, Frequency response analysis, Stability of linear systems in analog and digital domains, Controller design in analog and digital domain (different methods), Details of state variables in analog and digital domains, Lyapunov stability analysis.

EE209 CIRCUIT THEORY (3-1-0-5-3)

Overview of network analysis techniques, Network theorems, Transient and steady state sinusoidal responses. Network graphs and their applications in network analysis, Resonance, Coupled Circuits, Two-port networks, Z,Y,h and transmission parameters, combination of two ports, Analysis of common two ports, Network functions, parts of network functions obtaining a network function from a given part. Network transmission criteria; delay and rise time, Scattering matrix and its application in network analysis, Elmore's and other definitions of cascading. Elements of network synthesis techniques. Butterworth and chebyshev Approximation.

EE301 ANALOG CIRCUITS (3-1-0-5-3)

Diode and its applications, BJT based amplifier and its biasing schemes, MOSFET and/or based amplifier and its biasing schemes, Study of feedback741 based op-amp and its applications, Introductions to data converters, waveform generators and PLL, Introduction to recent advancements in analog circuit arena.

EE302 ANALOG CIRCUITS LAB (0-0-3-1.5-1.5)

BJT characteristics and single-multistage amplifier, Current source, Diode and its application as a FWR, BJT based differential amplifier, Op-amp 741 IC and its applications

EE303 COMMUNICATION ENGINEERING (3-1-0-5-3)

Review of Fourier series and Transforms. Hilbert Transforms, Band pass Signal and System Representation.Random Processes, Stationarity, Power Spectral Density, Gaussian Process, Noise. Amplitude Modulation, DSBSC, SSB, VSB: Signal Representation, Generation and Demodulation. Frequency Modulation: Signal Representation, Generation and Demodulation. Mixing, Super heterodyne Receiver, Phase Recovery with PLLs. Noise: in AM Receivers using Coherent Detection, in AM Receivers using Envelope Detection, in FM Receivers. Sampling, Pulse-Amplitude Modulation. Quantization, Pulse-Code Modulation. Noise Considerations in PCM. Time Division Multiplexing, Delta Modulation.

EE304 COMMUNICATION ENGINEERING LAB (0-0-3-0-1.5)

Generation of sequences and sequencing operations. Generation of random signals and performing different operations on them. Amplitude modulation and demodulation. Amplitude modulation and demodulation with AD633 (Analog Multiplier IC). FM modulation using IC555 and demodulation using slope detector. FM demodulation using slope detector: Demodulate the FM signal generated from the 555-timer (as VCO) using a slope detector circuit.

Generation of PAM signals and reconstruction. Generate a pulse width modulated (PWM) and

pulse position modulated (PPM) signal waveform by processing an analog signal.

EE305 ENGINEERING ELECTRO-MGNETICSM (3-1- 0-5- 3)

Vector Analysis: Review of vector algebra, vector calculus, and coordinate systems. Plane waves: Review of Maxwell's equations, Wave propagations in unbounded medium; Boundary conditions; Reflection and transmission of plane waves.
Transmission Lines Transmission Lines: Distributed parameter approach; Traveling and standing waves; Impedance matching, Smith chart and design. Waveguides: parallel-plane guide, TE, TM and TEM waves, rectangular and cylindrical waveguides, resonators. Planar transmission lines: Stripline; microstripline. Applications of numerical techniques. Radiation: Retarded potentials, Antenna parameters; Hertzian dipole, short loop. Radio-wave propagation: ground-wave, sky-wave, space-wave.

EE306 ENGINEERING ELECTRO-MGNETICS LABORATORY (0-0-3-3/2-1.5)

Introduction: Introduction to simulation software (PSICE and HFSS) and Laboratory equipments and instruments
PSPICE: Simulation of lumped element delay line and transmission line, **HFSS**: Simulation of transmission line in different modes, **Microwave Test Bench:** Experiments using Microwave test bench

EE307 POWER ELECTRONICS (3-1-0-5-3)

Introduction, Power Semiconductor Devices, Magnetics, DC-DC Converters, AC-DC Converters, DC-AC Converters
AC-AC converters.

EE308 POWER SYSTEMS LAB (0-0-3-1.5-1.5)

Power transaction between utilities in real-time, Network Planning, Overhead transmission line parameters, Reactive power requirement and slow voltage dynamics, Fault at generators, Fault clearance to maintain generator stability
Economics of real-time power generation

EE309 POWER SYSTEMS (3-1-0-5-3)

Essential fundamentals of power networks: Evolution of utility generation, transmission, and distribution – economies of scale. Daily load curves, type of generation resources and their allocation. Generic operation of generating units, intro to AGC. Normal, alert, and emergency modes. The Indian power industry Importance of reactive power management; HVDC and FACTS. Symmetrical components and unbalanced systems. Per-unit quantities. **Apparatus in power networks:**Transformers and tap changers. Synchronous generators. Transmission lines and cables. HVDC. Loads and power quality. **Analysis and operation:**Various aspects of power flows. Steady state, transient, dynamic, and voltage stability. SMIB and SLIB systems. Swing equations. Control of large interconnected power networks. **Protection:** Breakers and their role in protection. Relay coordination and circuit breakers. Balanced and unbalanced fault calculations. **Management of utilities:** The vertical utility and decentralized systems. Operational economics of the power industry: economic load dispatch and unit commitment. Privatisation, deregulation, and energy markets.

EE310 POWER SYSTEMS LABORATORY (0-0-3-3/2-1.5)

Power transacti on between utilities in real-time, Network Planning, Overhead transmission line parameters, Reactive power requirement and slow voltage dynamics, Fault at generators, Fault clearance to maintain generator stability, Economics of real-time power generation, Evaluations/Lab Exam

DEPARTMENT OF HUMANITIES & SOCIAL SCIENCES

HS101 HISTORY OF TECHNOLOGY (1.5)(3/2-1/2-0-5/2)

Early Greeks, Indus Valley Civilization, Nature and Science and Technology: India and the West, Mediation of Technology, Discipline Centred Historical Evaluation 1, Discipline Centred Historical Evaluation 2

HS102 ENGLISH LANGUAGE SKILLS (3) (2-2/3-2-13/3)

English Grammar, Language Skills—Basics, Language Skills—Advanced

HS103 PROFESSIONAL ENGLISH COMMUNICATION (3)(2-0-2-5)

Reading, Writing, Speaking

HS104 PROFESSIONAL ETHICS (1-1/3-1-13/6-1.5)

Ethics: General Introduction, Applied Ethics, Engineering Ethics: Challenges, Case Studies and Responses

HS201 ECONOMICS (3-1-0-5-3)

Micro Economics: Theory of Demand, Production and Cost Theories and estimations, Basics of different Market Structure, Macro Economics: National Income Accounting, IS-LM model, Inflation-unemployment nexus, Implications of these concepts in cross-country context , Indian Economics: Financial Sector Reforms in India, Trade policy Reforms in India (with applications to agriculture and industry), Concepts of Poverty and Inequality in India and measurement Issues

HS202 HUMAN GEOGRAPHY AND SOCIETAL NEEDS (3) (1-1/3-4-11/3-3)

Understanding Household and its Development: The module introduces the students towards the notion of developmental needs, parameters, etc. Employing census data to teach how development and science can be traced from the village level. **Organization of Societal Structure:** The module foregrounds the organizational pillars of the society like state (government), market (industry) and civil society (public) and academia (Knowledge) to understand the local socio-technical issues theoretically and conceptually. **Sectoral / Regional Engineering System:** The module introduces the regional Engineering Systems like irrigation facilities, Biomass energy production system, solar dryers, etc and its associated stakeholders such as NGO, state officers, etc. Examples of sector Water, Energy, Health, Sanitation, Food and Nutrition, small scale industries, ICT, pharmaceuticals, etc. The module also explains how the New Policies are evolved and implemented. **Introduction to Geographic Information System:** this module introduces District data set analysis, derives inferences, and finds the gap between policy and its implementation. **Field Visit and Identifying the Socio-Technological Problems:** Through this module**,** the course instructor would attempt to meet the different stakeholders within the technological system such as NGO, State officers, implementing agencies, local people, etc. to understanding their demands and needs. **Project Formulation Stage Cum Finalizing the Case study**: In this module, the course instructor helps the students to Identify the socio-technical problems (Engineering problems) and make them to carry forward to next stage that is technology development.

HS301 INDUSTRIAL MANAGEMENT (3-1-0-5-3)

Introduction to Management Principles and Organizational Behavior, Production and Operations Management

Fundamentals of Finance and Marketing

HUL485 PSYCHOLOGY AT WORKPLACE (3-0-0) (3)

Fundamentals of Organizational Psychology, Domains within Organizational Psychology. Psychological processes at work. Motivation; content and process theories of motivation. Job

Satisfaction: Measurement and factor affecting job satisfaction. Job Involvement and organizational commitment. Stress in the workplace: Sources, Effects and management. Work-Family Conflicts. Brief Introduction to Engineering Psychology: Person-Machine System, Workspace Design.

HUL486 BASIC PSYCHOLOGICAL PROCESSES (3-0-0) (3)

Introduction to the Psychology as an academic subject and to the Basic Psychological Processes. Nature of Intelligence. Brief introduction to Personality. Memory: Processes and Types. Forgetting: Nature & Causes. Motivation: Intrinsic/Extrinsic Framework, Theories of Motivation. Learning: Principles of Learning, Problem Solving: Barriers to effective problem solving.

HUL480 ONLINE ECONOMY AND DIGITAL MARKETING (3-0-0-6-3)

Introduction to Online Marketplace and marketing fundamentals: Introduction to online economy, ecommerce trends, Unique features of e-commerce technology, Economic forces in e-commerce, basic concepts of marketing.

E-Commerce Business Models : Introduction to business models, key elements of a business model, B2C & B2B business models, Business model canvas**, Introduction to Digital Marketing and marketing remix:** Online media channels, media types, only communication strategies, 5S elements of online marketing, marketing remix. **Online Customers:** 4I model of customer engagement, hierarchy of effect, managing customer's expectations, added value, e-customer profiling, customer personas, managing customer experience journeys. **Online Marketing Strategy:** Scope of online marketing strategy, online marketplace map, Intermediary analysis, segmentation strategy, SOSTAC's strategy framework, Situation analysis, resource analysis, demand analysis, goals, objectives & KPIs, strategic decision making **Online relationship marketing:** Shift from transactional marketing to relationship marking, customer relationship management (CRM), big data and CRM applications in customer propensity modeling, customer engagement strategy, voice of customers, customer lifetime value **Managing customer experience online:** Online customer experience pyramid, conversion rate optimization, managing website project, incorporating usability and business requirements, e-service quality, online retail merchandising **Campaign planning for digital media:** Online campaign metrics, volume measures, quality measures, cost measures, branding measures, measuring campaign efficiency, various tools of online marketing e.g., search engine marketing, search engine optimization (SEO). SEO influencers, affiliate marketing, display marketing, social media marketing, etc. Media selection criteria. **Ethical, Political and Social issues:** Moral dimensions of internet society, privacy and information rights, policies and legal protections, designing privacy policies for grey areas, governance and social welfare.

DEPARTMENT OF MATHEMATICS

MA101 CALCULUS (3) (3-1-0-5-3)

Single Variable Calculus: Limits and continuity of single variable functions, differentiation and applications of derivatives, Definite integrals, fundamental theorem of calculus, Applications to length, moments and center of mass, surfaces of revolutions, improper integrals, Sequences, series and their convergence, absolute and conditional convergence, power series. Taylor's and Maclaurin's series. **Multi-variable Calculus:** Functions of several variables-limits and continuity, partial derivatives, chain rule, gradient, directional derivatives, tangent planes, normals, extreme values, saddle points, Lagrange

multipliers. Taylor's formula. Double and triple integrals with applications, Jacobians, change of variables, line integrals, divergence, curl, conservative fields, Green's theorem, surface integrals, Stokes's Gauss Divergence theorem.

MA102 LINEAR ALGEBRA, INTEGRAL TRANSFORMS AND SPECIAL FUNCTIONS (3) (3-1-0-5-3)

Linear Algebra : Vector spaces over R and C, Subspaces, Basis and Dimension, Matrices and determinants, Rank of a matrix, System of linear equations, Gauss elimination method, Linear transformations, Rank-nullity theorem, Change of basis, Eigen values, Eigen vectors, Diagonalization of a linear operator, Inner product spaces. Spectral theorem for real symmetric matrices, application to quadratic forms. **Integral Transforms:** Laplace transforms of elementary functions, Inverse Laplace transforms and applications, Fourier series, Fourier transforms, Fourier cosine and sine integrals, Dirichlet integral, Inverse Fourier transforms, Special Functions: Gamma and Beta functions, Error functions

MA201 DIFFERENTIAL EQUATIONS (3) (3-1-0-5-3)

Ordinary Differential Equations: First Order Equation, Exact equations, integrating factors and Bernoulli equations. Lipschitz condition, examples on non-uniqueness. Second order differential equations with constant coefficients: homogeneous and non-homogeneous differential equations. Wronskian and linear independence of solutions, method of variation of parameters. Cauchy-Euler equations, method to second order equations with variable coefficients, Some applications, Solution of IVP using Laplace Transform and Euler's Method. Series solutions, Frobenius method, Legendere and Bessel equations, orthogonal properties of Legendre polynomials. **Partial Differential Equations:** Linear second order partial differential equations and their classification, heat equation, vibrating string, Laplace equation; method of separation of variables.

MA202 PROBABILITY AND STATISTICS (3) (3-1-0-5-3)

Probability: Axioms of probability, conditional probability, independence of two or more events, Bayes' theorem. Random variable, distribution functions, standard probability distributions and their properties, Simulation. Multiple random variables, marginal and conditional probability distribution, independence of random variables, bivariate normal and multinomial distributions. Functions of random variables, covariance and correlation. Conditional expectation, sum of random number of independent random variables. Convergence in probability, laws of large numbers and central limit theorem. **Statistics:** Sample, population, sampling techniques, descriptive statistics, popular sampling distributions. Point estimation, parameter estimation with MLE, interval estimation, hypothesis testing. Ordinary least Squares (OLS) regression, assumptions and limitations of OLS, inference concerning regression parameters, other regressions. Analysis of variance.

MA203, PROBABILITY AND STOCHASTIC PROCESSES, (3) (3-1-0-5-3)

Probability: Axioms of probability, conditional probability, independence of two or more events, Bayes' theorem. Random variable, distribution functions, standard probability distributions and their properties, Simulation. Multiple random variables, marginal and conditional probability distribution, independence of random variables, bivariate normal and multinomial distributions. Functions of random variables, covariance and correlation. Conditional expectation, sum of random number of independent random variables. Convergence in probability, laws of large numbers and central limit theorem. **Stochastic Processes:** Introduction and motivation, classification of stochastic processes,

Bernoulli process, Poisson process, Markov chains, single/multiple server queuing models, power spectral density

DEPARTMENT OF PHYSICS

PH101 PHYSICS FOR ENGINEERS (3-1-0-5-3)

Concepts and Newtonian Mechanics : Fundamental concepts, Newtonian Mechanics and Oscillationss

Fundamental of optics and em waves: Maxwell's' equations; Poynting vector, energy; wave equation in free space and medium, boundary conditions of em waves at interfaces. Huygen's principle, superposition of waves, Young's experiment, coherence of light, Interference by division of wavefront and amplitude, diffraction by single slit

Modern physics and quantum behavior:Limitation of classical mechanics, Heisenberg uncertainty principle; Schrodinger equation, particle in the box

PH102 PHYSICS FOR ENGINEERS LABORATORY (0-0-4-2-2)

To determine the Planck's constant by (a) Photoelectric effect (b) LED: Experiment to determine Planck's constant by Photoelectric effect and LED, and to verify the inverse square law of radiation using a Photoelectric effect cell.**a) To measure the magnetic flux density along z-axis of the circular coils when the distance between them a = R, R/2, 2R, where R = radius of the coils. (b) To measure the magnetic flux density along the radial direction as a function of axial coordinate z ahen the distance between the coils a = R.** Experiment to measure the axial and radial components of magnetic flux density produced by a pair of coils in Helmholtz arrangement **Study the in-phase, out-of-phase and beat mode of oscillation of two identical coupled pendulums and determine the coupling factor** Experiment to examine the different modes of oscillation of two coupled pendulums.

To determine (a) the wavelength of a diode laser by single-slit diffraction and (b) the separation between two slits using the above wavelength by double-slit diffraction Single-slit and double-slit diffraction experiments to determine wavelength of monochromatic source of light and/or slit width or separation. **Determine the wavelength of a monochromatic source using Newton's ring experiment.** Experiment to determine the wavelength of monochromatic source of light (sodium lamp) by examining the Newton's rings. **To study the common Base and common Emitter characteristic of a NPN transistor.** Experiment to measure the V-I (input & output) characteristics of NPN transistor. Designing the allotted project Designing the project and maintaining a project file.

DEPARTMENT OF MECHANICAL ENGINEERING

ME101 ENGINEERING MECHANICS (3-1-0-5-3)

Elementary Algebra and calculus of vectors. Introductions to mechanics, position, force and momentum. Degree of freedom, Free Body Diagram, Modelling of Rope/strings, Pulleys, Spring, and Friction. Static equilibrium of an object (Force and Moment balance). Beams, shafts, columns, trusses and frames (study of forces/moments only without considering

stress/strain). Inertial frame of reference, Derivative of a vector in a moving frame, Addition of angular velocities, Acceleration in a moving frame. Linear and angular momentum balance for system of particles and rigid bodies, Moment of Inertia. Kinetic Energy. Planar motion or 2D problems.

ME102 THERMODYNAMICS (3-1-0-5-3)

Definitions and concepts: System and CV, Macroscopic and microscopic view points; Property, Thermodynamics Static and Equilibrium, Energy, Work interaction and various modes of work, Heat: Zeroth Law of Thermodynamics, Temperature Scale, Properties of Pure Substances, Phase, Simple compressible substance, Mathematical, Tabular and Graphical representation of data; Ideal gas Van der Waals Equation of state; Compressibility chart; Thermodynamic Diagrams including Mollier diagram and Steam Tables, First law of thermodynamics and its applications to non-flow processes, Applications of first law of thermodynamics to flow processes; Steady flow and Transient flow processes, Second Law of Thermodynamics and its Applications, Availability, Gas power cycles, Vapor power cycles, Refrigeration cycles, Applications of first law of thermodynamics to chemically reacting systems, Thermodynamic potentials, Maxwell relations; Thermodynamic relations.

ME201 SOLID MECHANICS (3-1-0-5-3)

Historical background, Simple Stresses and Strains- Concept of stress and strain, Stress produced in axial loading, thermal stress, Compound Stresses and Strains, Generalized Hook'e Law, principal stresses and principal planes, Mohr's circle of stress, principal strains and principal axis of strain, Plane problems in mechanics, Thin-walled cylinders, Symmetric bending of beams, Types of beam supports, Bending moment (BM) and shear force (SF) diagrams, Beams under different types of loading e.g. point load, distributed load, moment etc., Theory of bending stresses- Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, shear stresses in beams., Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams, Torsion- Torsion of shaft with circular cross section, Applications of the equation of the hollow and solid circular shafts, torsional rigidity., Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion, Introduction to energy methods, Columns and Struts- Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length. Rankine Gordon's empirical formula.

ME202 MACHINE DRAWING (0-0-4-2-2)

Drawing standards and rules; Sheet layout; Lines, lettering and dimensioning; Various methods of projections; Sectional views. Orthographic reading, Introduction to CAD, Part modeling and generation of different views using CAD software, Screw threads; Screwed fastening; Keys, Cotter-joints and Pin-joints; Pipe joints; Riveted and Welded joints, Introduction to different types of valves; CAD modeling and assembling of different components of valves, Shaft bearing, brackets and hangers; Shaft coupling, clutches and brakes; Pulleys; Spur Gearing, Drawing of Engine Parts, CAD Modeling of engine parts (e.g. Piston, Connecting rod etc.) and assembling, Assembly drawing; Sectioning, Exploded views, Limits, fits and tolerances; Surface roughness, Practice sessions.

ME203 THEORY OF MACHINES (3-1-0-5-3)

Introduction- Historical background of Theory of Machines, General concepts, Introduction of simple mechanism, Different types of kinematics pair, Grublers rule for degree of freedom, Grashof's criterion for mobility determination. Inversions of 4R, 3R-P, 2R-2P chains, Kinematic Analysis- Concepts of graphical and vectorial analysis, Displacement, velocity and acceleration analysis of planar mechanisms, Cams- Classification, Cams with uniform acceleration and retardation, SHM,

Cylcloidal motion, oscillating followers, Gears- Geometry of tooth profiles, Law of gearing, Involute profile, Interference, Helical, spiral and worm gears; Simple and compound gear trains. Epicyclic gear trains – Analysis by tabular and relative velocity method, Dynamic Analysis- Dynamic analysis of mechanisms, Turning moment computations, Flywheel, Balancing- Static and dynamic balancing, Special topics (brief introduction) - Gyroscopes (simplest example) and Governers; their uses. Kinematics and dynamics of single and multi-cylinder engines.

ME204 FLUID MECHANICS (3-1-0-5-3)

Fluid definition, continuum hypothesis, no slip condition, concepts of pressure and stress, Hydrostatics: Equation of fluid at rest, pressure measurements, hydrostatic thrusts on submerged surfaces, buoyancy stability of submerged bodies, fluids under rigid body motion, Kinematics of fluid flow: Scalar and vector field, Lagrangian and Eulerian method, streamline, pathline and streakline. Rate of linear and angular deformation, Conservation of mass, conservation of momentum and energy, Bernoulli's equation and its applications like Hydraulic siphon, venturimeter, orificemeter and Pitot tube, Reynolds Transport theorem: conservation of mass, conservation of linear and angular momentum in inertial and accelerating reference frames, Flow of ideal fluids: Stream function, velocity potential, free and forced vortex, source and sink flow, doublet, flow about a cylinder without circulation and flow about a rotating cylinder, Viscous flows: Laminar pipe flow, Couette flow and thin film flows, Dimensional Analysis and types of similarity, Geometric, Kinematic and Dynamic. Buckingham's Pi theorem and Rayleigh's indicial method, Internal Flows of pipes and ducts: friction factor, losses, resistance in parallel and series pipes, Boundary layer theory: concept of boundary layer, momentum integral equation, drag and lift, separation, Compressible flow: Thermodynamic properties of perfect gas, speed of sound, basic equations for 1-D flow, stagnation and sonic properties, normal and oblique shocks.

ME205 DESIGN LAB-I (0-0-4-2-2)

Introduction to various measurement devices including measurement of displacement, velocity and acceleration of linear and angular motion. LVDT, accelerometer, strain gauge, load cell, torque cell, tachometer etc., Experimental determination of material properties such as Young’s modulus, shear modulus and Poisson’s ratio etc. Open and Closed cylinders. Bending and buckling of beams. Photo-elasticity experiments on uniaxial tension, bending of beams etc. Validation of above experiments through Mohr’s Circle, where ever applicable, Displacement, velocity and acceleration of 4-bar mechanism with two Inversions. Cam and follower, Gears, Gyroscope and Balancing, Design of experiments: defining objective, planning, execution and correlation with theory. Evaluation.

ME206 MANUFACTURING TECH-NOLOGY-I (3-1-0-5-3)

Introduction; Casting: basic process and types; Metallurgical characteristics of castings; Defects in casting and inspection; Product design considerations, Introduction; Welding and its types; Weldability; Metallurgical characteristics of welding; Defects in welding and inspection; Brazing, Soldering and Adhesive bonding; Product design considerations, Introduction; Forming and its types; Bulk and sheet metal forming processes; Analysis of forming processes; Precision forming processes; Defects and inspection; Tool/die life considerations; Product design considerations, Introduction; Fundamentals of Machining; Generatrix and Directrix; Orthogonal and oblique cutting; Various machining processes; Mechanics of machining; Cutting tools, geometry and materials; Single and multi-point cutting tools; Cutting fluids; Tool life and wear; Abrasive machining and Surface finishing operations; Product design and economic considerations, Introduction; Mechanical energy processes; Electrochemical energy processes; Thermal energy processes; Chemical energy processes; Product design considerations, Introduction; Manufacturing techniques for general polymer based products and their mold /die design

fundamentals; Manufacturing of composites; Autoclave molding, Pultrusion, Filament winding, Compression molding; Product realization with polymers, ceramics and composites, Advances in manufacturing technology.

ME207 MANUFACTURING LAB-I (0-0-4-2-2)

Casting processes beyond sand casting, Detailed machining of parts using lathe machines, Detailed machining of parts using milling and grinding machines, Annealing, quenching, tempering, Introduction to various metrological instruments and metallographical inspection of the parts manufactured in previous sessions, TIG, MIG, Spot, Oxy-acetylene, inspection of weld quality, Propose and execute manufacturing plan to fabricate a given assembly.

ME301 VIBRATIONS AND CONTROL (3-1-0-5-3)

Vibration of single degree of freedom (SDF) system, modeling of stiffness and damping (viscous and Coulomb). Estimation of damping by decay plots and half power method. Impulse, transient and forced vibration response of SDF systems. Resonance in undamped and damped SDF systems. Theory and practice of vibration isolation. Undamped and damped multi-degree of freedom systems and matrix eigenvalue problems. Modal analysis, Introduction to control of linear time invariant systems. Closed and open loop control. Laplace transform and transfer function. Block diagram and signal flow graph analysis. MATLAB implementation for Module 3, Review of time response of first and second-order systems (Unit Impulse and Step Input). Concept of stability and effect of pole locations. Routh's stability criterion. Effect of proportional, integral and derivative control on system performance. Steady-state errors and error constants. Root locus method of analysis and design. Lead and lag compensation. MATLAB implementation for Module 4, Frequency-response analysis. Relationship between time & frequency response. Bode Diagrams, Nyquist plots. Stability in frequency domain, Nyquist stability criterion. Compensation and their realization in time and frequency domains. MATLAB implementation for Module 5, Tuning of PID controllers with simple examples. State-space representation of systems. Review of solution of state equations. Concepts of controllability and observability. Pole placement design. MATLAB implementation for Module 6.

ME302 HEAT AND MASS TRANSFER (3-1-0-5-3)

Heat conduction equation, heat diffusion equation, 1-D steady state conduction in extended surfaces, infinite and semi-infinite walls, heat generation, lumped capacitance and simple transient models, boundary and initial conditions, Convection equations for flat plate, forced and free convection - mass, momentum and energy conservation equations, non-dimensional numbers, similarity, hydrodynamic and thermal boundary layers, basics of heat transfer in external and internal laminar and turbulent flows, entry region, and use of correlations, Physical phenomena and co-relations, pool boiling, flow boiling, film and dropwise condensation, heat exchanger fundamentals and design, Black body radiation, radiation intensity, properties, laws, 3-surface network for diffuse-gray surfaces, Mass diffusion, Fick's law, similarity with convection and correlations.

ME303 THERMO-FLUIDS LAB-I (0-0-2-1-1)

Introduction to measuring equipment's accuracy, resolution and calibration. Measurement of fluid flow rate, flow conditions, flow visualization to understand the fluid and its flow characteristics. Experiments on fluid flow systems such as pumps, turbine etc., The student will work on experiments related to their project work on topics such as measurements of thermo-fluid parameters, operational conditions etc.

ME304 MACHINE DESIGN (3-1-0-5-3)

Understanding the need of high performance and efficient machines. Identification of functional requirements. Conceptualizing the geometric shape to fulfil the functions, Stress analysis: Estimating

various stresses under static and dynamic load conditions. Understanding failure theories, Design/select machine components: Cotter joint, Knuckle joint, Levers Welded and Riveted joints Lubrication and Bearings Flexible mechanical elements: V-belts, Flat belts, Ropes, Chain drives Gears Shafts, Keys, Couplings, Axles, Spindles Screw fasteners and connections, Power Screws Springs Flywheels, Clutches, Brakes, Coupling. e.g. Gearbox driven by motor using belt drive) through use of parametric software to carry out iteration in the design space.

ME305 MANUFACTURING TECH-NOLOGY - II (3-1-0-5-3)

Introduction; manual labor and automation in production system; automation principles and strategies, Automation fundamentals; levels of automation; continuous and discrete control; computer process control; Numerical Control (NC); Computer Numerical Control (CNC); Direct Numerical Control (DNC), Material handling; fundamentals of production lines; manual assembly lines; automated production lines; line balancing; group technology and cellular manufacturing; flexible manufacturing systems and cells; computer integrated manufacturing, Process planning; forecasting; aggregate planning and master production scheduling; storage systems; material and capacity requirements planning; inventory control; quality control, Problem formulation by linear programming; simplex method; transportation, assignment and network flow models; Critical Path Method (CPM); Program Evaluation and Review Technique (PERT); inventory models; Simulation techniques.

ME306 DESIGN LAB-II (0-0-3-1.5-1.5)

Introduction to various measurement devices such as CRO, data acquisition systems etc. Signal processing, filters, signal generators etc., Study of Single Degree of Freedom (SDOF) system: Free damped and forced systems including unit impulse and step loading. Introduction to proportional and derivative controller using springs and dashpots. Frequency domain analysis with study of natural frequency, Study of Multiple degree of freedom system with modal analysis, PID controller design and analysis in time and frequency domain, Design of experiments: defining objective, planning, execution and correlation with theory. Evaluation.

ME307 THERMO-FLUIDS LAB-II (0-0-3-1.5-1.5)

Measurement of temperature, flow conditions, heat transfer equipments etc related to modes of heat transfer. Experiments on thermal systems thermo-physical parameters. The student will work on experiments related to their project work on topics such as measurements of thermo-physical parameters, operational conditions etc.

ME308 MANUFACTURING LAB-II (0-0-4-2-2)

Learning Part programming through CAM compatible software, Dry run and Computer Added manufacturing Practice, Introduction and practice of non-conventional manufacturing processes, such as EDM, LBM, Shearing, bending, forming, riveting, Modelling and simulation. Part manufacturing, Injection molding and extrusion of polymers, sintering of ceramics, hand lay-up and compression molding of PMCs, adhesive bonding, Software based learning of concepts related to operations research and management, Propose and execute manufacturing plan to fabricate a given assembly.

EXTRACURRICULAR

NS 101 NSSI (1) (0-0-2-1)
NSS in Semester I
NC 101 NCC I (1) (0-0-2-1)
NCC in Semester I
NO 101 NSO I (1) (0-0-2-1)
NSO in semester I:- One hour in the morning for physical training/exercise and one and half hour in the evening for sports training/practice.

NS 102 NSSII (1) (0-0-2-1)
NSS in Semester II
NC 102 NCC II (1) (0-0-2-1)
NCC in Semester II
NO 102 NSO II (1) (0-0-2-1)
NSO in semester II: - One hour in the morning for physical training/exercise and one and half hour in the evening for sports training/practice.

NS103, NSSIII, 0-0-2-1-1
NSS in Semester I
NC103, NCC III (0-0-2-1-1)
NCC in Semester I
No103 NSO III 0-0-2-1-1,
NSO in semester I: - One hour in the morning for physical training/exercise and one and half hour in the evening for sports training/practice. NO 104**,** NSO IV, 0-0-2-1-1

NS104, NSSIV, 0-0-2-1-1
NSS in Semester II
NC104, NCC IV (0-0-2-1-1)
NCC in Semester II
NO104 NSO IV (**0-0-2-1-1)**
NSO in semester II:- NSO II One hour in the morning for physical training/exercise and one and half hour in the evening for sports training/practice.