Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World
Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana
Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata
Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads
Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The
form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability
Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma’s words “it is a big step in restoring the lost harmony of nature”.

Benefits of Indian Medicinal Systems
Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India
India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is “Unity in Diversity” and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India
Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshiptfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

15CHE111 INTRODUCTION TO CHEMICAL ENGINEERING 3 0 0 3

Unit 1
Historical evolution of chemical engineering; what is chemical Engineering; the impact & role of chemical engineering; representing chemical processes using process diagrams and flow sheets (introduction to unit operations and unit processes; batch vs. continuous operation); understanding prevalent symbols; chemical process industries: evolution, broad classification, characteristics, origin, growth, present scenario, & projections; opportunities and challenges; roles of the modern chemical engineer.

Physical quantities: units & dimensions, conversion & conversion factors; important process variables, making the connection between the variables and their measurements; conventions in methods of analysis and measurement, basis, chemical equations and stoichiometry, conversion, and yield; industrially important physical and chemical properties.

Unit 2
Introduction to fluid flow (pressure-flow interaction, non-flowing fluids, pumps & turbines), heat transfer (applications of heat exchange in the industry), mass transfer (molecular vs. bulk transport), reaction engineering (important of describing reaction rate and design of reaction vessel), materials (important properties and their influence on selection of materials), and control (need for control and strategies); mathematical representation of process; types of chemical engineering problems (mainly rate, equilibrium and design).

Unit 3
Computer aided calculations & spreadsheets; graphing (basic plots, interpreting trends, curve fitting, log-log & semi-log representation); relation between chemical engineering and physico – chemical sciences and other engineering disciplines; modern view of chemical engineering; economics (costs in industry, profitability considerations, analytical view of process and reporting of performance); safety-health-environment; ethics; case studies.

TEXTBOOKS & REFERENCES:
Representing streams: Dimensions and unit conversions, Conversion factors, Dimensional consistency, Dimensionless numbers in chemical engineering; Representing compositions of mixtures and solutions: Binary and ternary mixtures, Graphical representation, Compound stoichiometry; Representing gas phases: Ideal gas law, P-V-T calculations, Partial pressures and pure component volumes in mixtures; Representing reactions: Reaction stoichiometry, Conversion, Yield, Selectivity, Limiting and excess reactants; Dissociating gases; Representing moist gases: Humidity, Wet and dry bulb temperatures, Humidity chart.

Unit 2
Material balance – Control volume, Conservation of mass and species in a unit; Steady and unsteady state processes, Batch and continuous processes; Basis for calculation; Degrees of freedom; Steady and unsteady material balance in unit operations: Evaporation; Crystallization; Leaching; Adsorption; Drying; Liquid-Liquid Extraction; Absorption; Distillation; Recycle, Bypass, and Purge

Unit 3
Combustion: Orsat analysis, Proximate and ultimate analyses of coal; Single-pass and overall conversions; Oxidation of sulphur compounds; Reactions involving phosphorus; Reactions involving nitrogen; Reactions involving chlorine; Extraction of metals from ores; Hydrogenation, hydration, and oxidation; Electrochemical reactions; Recycle, Bypass, and Purge involving reactions

Representing processes: Creating Flowsheets; Degree of freedom analysis of flowsheets; Material balance involving multiple unit operations; Modular and overall equation-solving approaches; Case studies involving industrial flowsheets.

TEXTBOOKS:

REFERENCES:

SYLLABI
B. Tech - Chemical Engg.
2015 admissions onwards

SYLLABI
B. Tech - Chemical Engg.
2015 admissions onwards

15CHE201 ENERGY BALANCE AND THERMODYNAMICS 3 0 2 4

Unit 1
Systems, Properties, Processes, Cycles; State of a system and state postulate; State and path functions; Temperature and zeroth law of thermodynamics; Pressure and pressure measurement; Energy and its forms: Potential and Kinetic energy, Internal energy; Energy sources; Energy transfer – Heat, Work, Electricity; Mechanisms of heat transfer; Work: Moving boundary work, Flow work, Shaft, spring, elasticity, surface tension, and electrical work; Energy balance – First law for open and closed systems, steady and unsteady state processes.

Phases and phase diagrams of a pure substance, Saturation, Superheating, T-v, P-v, P-T diagrams and the P-v-T surface; Enthalpy; Property tables; Ideal and non-ideal gases: van der Waals, Soave-Redlich-Kwong, Peng-Robinson equations of state; Virial equation and its physical meaning; Compressibility factor.

Unit 2
Estimation of heat capacities: Solids, Liquids, Gases, Mixtures, Temperature dependence; Enthalpy changes: Mixing, Fusion, Vaporization – Clayperon equation, Clausius-Clayperon equation, Watson equation, Trouton’s rule, Kistyakowsky equation; Energy analysis of gas cycles; Energy analysis using property tables.

Mechanical energy balance – Bernoulli equation; Energy transfer by mechanical work: Nozzles and diffusers, Turbines, compressors and pumps, Throttling valves, Pipe and duct flow; Energy transfer by heat: Heat exchangers, Boilers and Furnaces; Energy balance in unit operations: Mixers and splitters; Drying; Evaporation; Crystallization; Leaching; Adsorption; Liquid-Liquid Extraction; Absorption; Distillation; Recycle, Bypass, Purge.

Unit 3
Standard heat of reactions – Combustion and Formation; Hess’s law; Effect of temperature and pressure; Adiabatic reaction temperature; Recycle in reactors; Combined material and energy balance in flowsheets – Degree of freedom analysis; Modular and overall equation-solving approaches.

Entropy and thermodynamic temperature; Combined first and second law for closed systems and cycles: Carnot cycle; Refrigerators, Heat pumps; Thermodynamic efficiency and coefficient of performance; Second law for open systems – Entropy balance; Statistical meaning of entropy.

TEXTBOOKS:
SYLLABI  B. Tech - Chemical Engg.  2015 admissions onwards


REFERENCES:

15CHE202  FLUID MECHANICS  3 1 0 4

Unit 1
Elementary concepts – density, specific weight, specific gravity, viscosity – dynamic and kinematic viscosity – surface tension, capillarity, vapour pressure, compressibility – Compressible and incompressible fluids; Concept of gauge and absolute pressure, measurement of pressure using manometers of different types. Hydrostatic force on plane and curved surfaces, center of pressure; buoyancy and stability of submerged and floating bodies;

Flow types - Unsteady, Steady and non-uniform, laminar and turbulent flows – Reynolds number; Ideal flow – rotational and irrotational, stream function, potential function – Velocity vectors; Path line, streak line and stream line; Derivation of continuity and momentum equation for steady three dimensional flows - Application of one dimensional steady flow; circulation and vorticity; Laminar flow between parallel plates – Taylor-Couette flow and Poiseuille flow; Flow in closed conduits Laminar flow through circular pipe – Shear stress and velocity profiles; pressure gradient, Hagen-Poiseuille’s equation; Power required to overcome pressure drop; Velocity profile in turbulent flows;

Two dimensional flows - Boundary layer; Boundary layer equation; Blasius solution for boundary layer flow; boundary layer separation and its control.

Unit 2
Bernoulli’s and Euler’s equations; Application of Bernoulli’s equations to flow meters - Pitot tube, Nozzle. Venturi meter and Orifice meter; Coefficient of discharge for flow meters and velocity measurement;

Concept of friction and friction factor from drag on a flat plate; Friction loss in laminar and turbulent flows, Darcy-Weisbach equation, Moody chart; Minor losses – Pipe fittings and pipe networks, equivalent length for pipe in pipe fittings;

Flow past immersed bodies – drag and lift, drag and lift coefficients, flow though beds of solids, one dimensional motion of particle through fluid, terminal velocity, hindered settling, Fluidization – Conditions for onset of fluidization, Hydraulic radius of porous medium, Porous medium Reynolds number, minimum fluidization velocity; Pressure drop through porous media for spherical and non-spherical particles – Ergun equation; Types of fluidization;

Unit 3
Applications Transportation of fluids – pipes, fittings, valves; Pump terminology – Suction and Delivery heads, Suction lift, Cavitation, Net positive suction head and Power requirement; Positive displacement pumps – Reciprocating pump and gear pump; Rotary pumps - Centrifugal Volute pump, Pressure raise in centrifugal pump; Pump characteristics;

Significance of dimensionless numbers; Dimensional analysis and model testing – Bucking ham pi-theorem; Application of dimensionless analysis - Flow through pipe, Settling of particles in a fluid, Centrifugal pump, Reynolds and Froude numbers and their use in model testing;

TEXTBOOK AND REFERENCE BOOKS:

15CHE203  MECHANICAL OPERATIONS  3 0 3

Unit 1
Properties and handling of particulate solids- characteristics of solid particles, standard screen series, mixed particle size and screen analysis; Screening: Theory of screening, Effectiveness and Capacity of screens, Screening equipment: stationary screens and grizzlies, gyrating screens, vibrating screens and other industrial screens like trammels, etc. Transportation and storage of solids: bins, hoppers and silos, flow out of bins; conveyor selection, different types of conveyors and their performance characteristics.

Comminution of solids (Size Reduction): Factors affecting comminution, comminution laws: Kick’s law, Rittinger’s law and Bond’s law and their limitations. Crushing efficiency & power consumption, Size reduction equipments: Primary crusher – Jaw crusher, Gyratory crusher. Secondary crusher – Roll crusher (both smooth roll & toothed roll) its selection and capacity, Grinder – Construction and operation
of Hammermill, Ball mill, Rod mill, Attrition mill, Agitated mill and their materials suitability. Ultra-fine grinder – Fluid energy mill, Cutting machines: knife cutters, Close circuit and Open circuit operation.

**Unit 2**
Separation of solids: gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, bowl classifier, super centrifuges, design of basket centrifuges; Industrial dust removing equipment - cyclones and hydro cyclones, with special reference to electrostatic and magnetic separators; Heavy media separations, floatation.

Mixing and Agitation: Mixing of liquids (with or without solids), mixing of liquids (with solids), mixing of powders, selection of suitable mixers, power requirement for mixing.

**Unit 3**
Filtration: Principle of Cake filtration, Pressure drop through filter media, compressible and incompressible filter cakes, Constant pressure and rate filtration, Continuous filtration, washing of filter cakes; Filtration – Theory, Filtration considerations, Batch and continuous filtration equipment (Pressure and Vacuum) – selection, operation and design of filters and optimum cycle of operation.

**TEXTBOOKS:**

**REFERENCE:**

**15CHE211 CHEMICAL ENGINEERING THERMODYNAMICS  3 0 0 3**

**Unit 1**
Pure gaseous substances – P-v-T behavior of pure substances, Calculation of work done, heat transferred, change in enthalpy in different processes – Ideal and Non-ideal gases; Equation of State, Compressibility factor.

Gas Mixtures – P-v-T behavior of gas mixtures, ideal and non-ideal mixtures, Mixture rules, Compressibility factors for mixtures.

**SYLLABI**

**B. Tech - Chemical Engg. 2015 admissions onwards**

Excess properties of mixtures – Temperature and Pressure dependence, Gibbs-Duhem equation;

**Unit 2**
Ideal and non-ideal solutions; vapor pressure of solutions; fugacity and activity coefficients and their estimation; Criterion for vapor liquid equilibrium (VLE); Binary VLE – Bubble and dew point calculations – Equation of State and Activity Coefficient models; Multi-component VLE – K-factor approach; Thermodynamic consistency of VLE data.

Criterion for liquid-liquid equilibrium; Estimation of distribution co-efficient from activity models; Composition estimation in problems related to extraction.

**Unit 3**
Criterion for chemical reaction equilibrium – feasibility of chemical processes, Equilibrium constant;

Conversion calculations in a reaction – Homogeneous gas phase reactions, Gas-Liquid reactions, effect of temperature and pressure on conversion.

**TEXTBOOK AND REFERENCE BOOKS:**

**15CHE212 CHEMICAL TECHNOLOGY  4 0 0 4**

**Unit 1**
Chemical processing, the role of a chemical engineers in process industries, importance of block diagrams and flow charts, unit operations, unit processes, process utilities and economics, industrial safety and pollution, outline of plant and equipment design, process control and instrumentation; Chlor-Alkali: Definition of electrochemistry, manufacture of soda ash by solvay process, manufacture of chlorine & caustic soda by diaphragm cell, advantages & disadvantages of diaphragm & comparison with mercury cell. Cement: Definition of cement & portland cement, process description, raw material, flow sheet & major engineering problems associated with the dry processes for manufacturing of portland cement; Glass & Ceramics: Definition and general composition of glass, raw material, methods of manufacture, special glasses - fused silica and high silica glass; Ceramics – properties, classification, manufacturing process; Types of refractories and manufacturing processes; kilns. Inorganic Acids: Flow sheet, raw materials, industrial
applications, and engineering problems for Sulfuric acid (includes production of Sulfur) and Hydrochloric acid. Soap & Detergent industry: Continuous hydrolysis & saponification process, flow sheet for continuous process, for fatty acids, soap & glycerine; types of surface active agents, different constituents of detergent, manufacturing process of detergent (sulfonation and sulfation and compounding of detergent). Vegetable Oils: Extraction methods, hydrogenation of vegetable oils, general methods of production; Pulp & Paper Industry: Kraft process for pulp manufacture, Fourdrinier and Cylinder Machine processes for paper manufacture, and paper finishing;

Unit 2
Fertilizer Industry: mixed and direct-application fertilizers, NPK value, granulation, Haber process for Ammonia synthesis; Petroleum Refining Industry: Constituents of petroleum, products of refining, processing or refining; Petrochemicals Industry: Unit operations, chemical conversions, manufacture of petrochemicals, reactions producing petrochemicals; Paints & Varnishes: Brief description of requirements for surface coatings, simple flow sheet of paint coatings, simple flow sheets of paint manufacturing process, varnishes & their applications; Dyes and Intermediates: Raw materials, important cyclic intermediates, chemical conversions, structure and classification of dyes.

Unit 3
Polymers & Plastics Industries: Definitions, types of polymers, classifications, polymerization reactions, manufacture of PE, PP, PVC; Phenolic and epoxy resin. Rubber Industries: Natural and synthetic rubber, rubber compounding, rubber fabrication, latex compounds, and rubber derivatives; Pharmaceutical: Classification, alkylation, condensation and cyclization, dehydration, halogenations, oxidation, sulfonation, amination. Fermentation process; Manufacture of antibiotic - Penicillin, Streptomycin and Erythromycin; Biologicals. Food industry: Types of processing (refining & milling, canning, concentration, freezing, drying, pasteurization); Sugar: Manufacture and refining of cane sugar, decolorization, bagasse, beet sugar.

TEXTBOOKS:

REFERENCES:
venturimeter, orificemeter, rotameter; Pipe friction studies - friction factor; Flow through annular and helical coil pipes - coefficient of friction; Performance characteristics of centrifugal and reciprocating pumps; Flow through packed columns – fluidization - pressure drop in the column; Terminal settling velocity.

15CHE282 MECHANICAL OPERATIONS LAB. 0 0 2 1

Calculating Specific Surface Area and Particle Size using Sieve Analysis, Screen Effectiveness, Verifying crushing laws and energy consumption in Jaw Crusher, Ball mill and Drop weight Crusher, Determining reduction ratio in Roll Crusher, and Drop Weight Crusher, Solid Separation in Cyclone Separator, Calculation thickener area using batch sedimentation experiment, Determining Specific Cake resistance and filter medium Resistance in Filter Press, and Leaf Filter.

15CHE285 CHEMICAL ENGINEERING INSTRUMENTATION LAB. 1 0 2 2

Measurements – Units and Dimensions, Unit Conversions, Significant Figures, Uncertainty in Measurements: Standard Error, Standard Deviation, Sampling and Confidence Intervals; Rating an Instrument – Interval, Range, Resolution, Sensitivity, Detection Limit, Repeatability, Reproducibility, Accuracy and Precision; Graphical Representation of Data – Scatter Plots, Linear, Log-Linear and Log-Log Plots, 3D and Contour Plots, Bar Charts

Pressure Measurement (Two Experiments) – Atmospheric, Gauge, Differential, Vacuum, Barometric Pressure, Static vs. Dynamic Pressure; U-tube Manometer, Capsule Gauge, Thermal Gauge, Capacitive Gauge, Ion Gauge; Safety: Pressure Regulator, Relief Valves, Rupture Disks, Pressure Test and Leak Test;

Temperature Measurement (Two Experiments) – Wet Bulb, Dry Bulb Temperatures and Dew Point; Thermometers, Thermistors, Resistance Temperature Devices (RTD), Thermocouples, Thermopiles, Pyrometers;


Analysis of Solids and Powders (One Experiment) – Bulk and Particle Density; Particle Size and Size Distribution – Sieve Analysis, Diffraction, Microscopy;

Concentration and pH in Gases and Liquids (One Experiment) – pH Meters, Introduction to Chromatography, Mass Spectrometry, Refractometry, Spectroscopy

15CHE286 CHEMICAL TECHNOLOGY LAB. 0 0 2 1

1. Estimation of the percentage of nitrogen in urea by Kjeldahl’s method
2. Determination of the percentage of available chlorine in the given sample of bleaching powder.
3. Determination of acid value and iodine value of different oils (any two)
4. Estimation of saponification value of different oils (any two)
5. Determination of alkalinity and Total fatty matter by Soap analysis (any two)
6. Analysis of Flash point of a given oil (any two)
7. Determination of viscosity by red wood viscometer
8. Estimation of silica and moisture content in cement analysis.
9. Determination of sucrose content in the given sample of sugar
10. Analysis of the percentage of ash and lactose content in the given milk sample.

15CHE301 CHEMICAL REACTION ENGINEERING I 3 0 0 3

Unit 1
Elementary reactions - Rate equation and rate law, temperature dependency of rate of reaction (rate constant) – Arrhenius, Collision and Transition State Theories.
Non-elementary reactions, mechanisms of non-elementary reactions – the pseudo steady state hypothesis (PSSH).

Analysis of Batch Reactor Data – Integral and Differential analysis of data, rate parameter estimation using least square analysis and curve fitting.

Unit 2
Design / performance equations for homogeneous and Isothermal systems – Batch, mixed flow and tubular reactors; size comparison of different reactors for single reactions; Rate parameter estimation using experimental data from various reactors.

Combination of reactors for a single reaction; Mixed Flow Reactors in Series; Combined Reactors in Series – Plug flow followed by mixed flow and vice versa. Parallel reactors – feed distribution in parallel reactor configuration; Auto catalytic reactions - Recycle reactors, Optimization of recycle ratio.
Unit 3
Multiple reactions – series, parallel and series-parallel reactions; Conversion and Selectivity; Reactor design for series reactions; Reactor design for parallel reactions; Reactor design for Series-parallel reactions;
Adiabatic reactions; heat of reaction as a function of temperature; Temperature as a function of Conversion and vice versa; Cooling / heating requirements in near-isothermal operation; Effect of temperature on conversion and selectivity in multiple reactions;

TEXTBOOK AND REFERENCE BOOKS:

15CHE302 DIFFUSIONAL MASS TRANSFER OPERATIONS
Unit 1
Molecular diffusion in fluids, Fick's Law of diffusion, steady state diffusion under stagnant and laminar flow conditions. Diffusivity measurement and estimation, multi-component diffusion, diffusion in solids and its applications, eddy diffusion, mass transfer coefficients, theories of mass transfer, analogy equations, application of empirical correlations to known geometry such as flat plates, wetted wall columns. Concept of mass transfer coefficients, inter phase mass transfer, two film theory, relationship between individual and overall mass transfer coefficients. Mass transfer in fluidized bed, flow past solids and boundary layers. Equipments for countercurrent and concurrent mass transfer operations.

Unit 2
Unit 3
Torsion of circular sections; Derivation of torsional formula – Assumptions made
Power transmitted – Solid and hollow shafts. Complex stress; principal stresses
and principal planes - principal strains – graphical method. Thin Shells; Thin cylindirical
shells subjected to internal pressure – Circumferential stress – Longitudinal stress –
change in diameter – length-volume – Thin spherical shells. Columns; Axially loaded
Columns – Different end conditions – Euler’s formula for long columns.

TEXTBOOKS:
REFERENCES:

15CHE311 CHEMICAL REACTION ENGINEERING II 3 0 0 3

Unit 1
Steps in heterogeneous reactions – bulk diffusion, internal diffusion, adsorption,
desorption and surface reaction; Rate expressions for different steps in heterogeneous systems; Thiele modulus and effectiveness factor.

Flow regimes in Gas-Solid and Liquid-Solid systems; Estimation of overall mass transfer coefficient in heterogeneous systems; Design of packed-bed, fluidized bed, slurry and trickle bed reactors;

Unit 2
Relative rates of reaction and mass transfer in non-catalytic reactions in Gas-
liquid reactions – Hatta number; Effect of gas solubility on rate of reaction;

Models for fluid-solid reactions: Progressive conversion model and Shrinking core model; Rate controlling steps in fluid-solid non-catalytic systems; Reactor design for non-catalytic reactions.

Unit 3
Non-ideal mixing in reactors; Estimation of mean residence time distribution and dispersion in mixing vessels using tracer studies; Dispersion model and Tanks-in-Series model.

TEXTBOOK AND REFERENCE BOOKS:

Unit 1
Design of mass transfer equipment based on the concept of equilibrium stage;

Distillation: vapor-liquid equilibria, Raoult’s law and deviations from ideality, methods of distillation; Equilibrium and operating line concepts; Design calculations by McCabe-
Thiele and Ponchon-Savarit methods; Continuous contact distillation (packed tower) design; Extractive and azeotropic distillation, low pressure distillation; Steam distillation; Tray tower equipment.

Unit 2
Absorption: Design of tray tower absorbers; Operating characteristics of stagewise and differential contactors; Design calculations for single stage, multistage concurrent and countercurrent absorbers.

Liquid-liquid extraction: Equilibrium in ternary systems; Design calculations for batch and continuous extractors, equipment – spray, packed and mechanically agitated contactors; Pulsed extractors, centrifugal extractors.

Unit 3
Leaching: Solid-liquid equilibria; Equipment – batch and continuous types; Calculation of number of stages.

Adsorption and Ion exchange: Theories of adsorption of gases and liquids; Principle of ion exchange; Equipment for batch and continuous operation; Design calculations for adsorption and for ion exchange resins.

Miscellaneous separation processes: Introduction to membrane separation process; Solid and liquid membranes; Reverse osmosis; Electrodialysis.

TEXTBOOKS:
REFERENCES:
15CHE313 MATERIALS TECHNOLOGY

Unit 1

Unit 2

Unit 3

TEXTBOOKS:

REFERENCES:
1. L H Van Vlack, Elements of Materials Science and Engineering, Pearson India 2008

15CHE314 PROCESS DYNAMICS AND CONTROL

Unit 1
Laplace transformation, transform of standard functions, derivatives and integrals; Open–Loop systems, first order systems: concept of transfer functions, transient response for standard input functions, physical examples of first order systems, first order systems in series, linearization and its application in process control, second order systems and their dynamics, transportation lag.

Unit 2
Closed loop control systems, development of block diagram for feedback control systems, servo and regulatory problems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers; transient response of closed – loop control systems; stability of control systems:Routh-Hurwitz criterion, root locus diagrams.

Unit 3
Frequency response of closed – loop systems,control system design by frequency response techniques, bode diagram and stability criterion, tuning of controller settings.Introduction to advanced control systems - cascade control, Feed-forward control; Control of chemical processes.

TEXTBOOKS:

REFERENCE BOOKS:

15CHE381 HEAT TRANSFER LAB.

Thermal conductivity of solid materials, transient heat conduction, electrical analogies, natural convection, forced convection, heat transfer in pool boiling, condensation heat transfer, steady and un-steady state heat transfer through submerged coils in agitated vessels. Radiation heat transfer, characteristics and efficiency of heat transfer equipments such as heat exchangers, jacketed pans and evaporators.

15CHE382 STRENGTH OF MATERIALS LAB.

Tensile test on metals and wires - determination of tensile strength, modulus of elasticity, percentage elongation; Hardness tests - Rockwell, Brinell hardness
number; Impact test - Izod and Charpy - impact strength, energy and modulus estimation: Compression test; Torsion test on shafts - determination of Shear stress and modulus of rigidity; Static bending test – fibre stress at limit of proportionality, resilience, modulus of elasticity; Fatigue test - S-N curves; Deflection test on beams; Double shear test.

15CHE385  CHEMICAL REACTION ENGINEERING LAB.  0 0 2 1
Lecture on RTD studies; Study of kinetic expressions for first and second order reactions, kinetic studies in batch reactor, Semi batch reactor, Sono batch reactor, CSTR, PFR, Combined reactor in series, RTD study in CSTR in series, RTD study in a PFR.

15CHE386  MASS TRANSFER LAB.  0 0 2 1

15CHE390 / 15CHE490  LIVE-IN-LAB.  3 cr
This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after fourth semester or sixth semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth or seventh semester. The objectives and projected outcome of the project should be reviewed and approved by the Dept. chairperson and a faculty assigned as the project guide. On completion of the project, the student shall submit a detailed project report. The report shall be evaluated and the students shall appear for a viva-voce test on the project.

15CHE391  PROJECT BASED LEARNING - PHASE I  1 cr
 Students will study a core Chemical engineering elective and discuss the theoretical (analytical and design) aspects of the subject matter. A minimum of two homework assignments will be given.

At the beginning of the semester, the instructor in consultation with the project group, will assign a project topic (from the elective selected) so that it covers the key concepts associated with the elective subject.

15CHE396  PROJECT BASED LEARNING - PHASE - II  2 cr
Students will apply the concepts that they have studied in Project Based Learning - I, and proceed with executing the project as per plan. The instructor provides guidance through tutorial classes to help the students to master problem solving and analytical aspects. There will be requirement of literature review report, two mid-project reports and a final report, each of which will be used towards course evaluation.

15CHE401  PROCESS DESIGN AND INTEGRATION  3 0 0 3
Unit 1

Reactor Network Synthesis - Reactor type and conditions for reaction systems, geometric techniques for synthesis of reactor networks.

Unit 2

Unit 3

TEXTBOOK:
SYLLABI  B. Tech - Chemical Engg.  2015 admissions onwards

REFERENCES:

15CHE402  PROCESS EQUIPMENT DESIGN AND DRAWING  2 0 2 3
Design and drawing of chemical engineering equipments – hydrodynamic design, process design, mechanical design and drawing of the following equipments:

Unit 1
Pressure Vessels, Storage Tanks, Heat exchangers, Condensers.

Unit 2
Evaporators, Dryers, Cooling towers, Crystallizers.

Unit 3
Absorption columns, Distillation columns, Extraction columns, Reactors.

TEXTBOOKS:

REFERENCES:

15CHE403  TRANSPORT PHENOMENA  3 1 0 4
Unit 1
Review of basic vector algebra and introduction to tensors, Macroscopic – Microscopic-Molecular views of phenomena; Momentum Transport: viscosity, pressure and temperature effect on viscosity of gases and liquids, Newton's law of viscosity, mechanisms of momentum transport, non-Newtonian fluids & power-law models, derivation of velocity profile using shell balance method, velocity distributions in falling film and circular tube; equations of continuity, motion, and mechanical energy; use of equations of change to solve flow problems; unsteady viscous flow.

Unit 2
Energy Transport: Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanisms of energy transport, derivation of temperature profile using shell energy balance (with electrical, nuclear, viscous and chemical heat source); temperature distribution in solids and laminar flow, heat conduction through composite walls, and cylinders; Combined energy flux vector; equation of energy (alternate forms) - applications to specific systems (forced convection laminar flow in tube, tangential flow in annulus, transpiration cooling); unsteady heat conduction in solids.

Unit 3
Mass Transport: Diffusivity, mechanisms of mass transport, concentration distribution in solids and in laminar flow, Fick's law, temperature and pressure effect, theory of diffusion in gases and liquids, types of diffusion (ordinary, thermal, pressure, and forced), mass and moles transport, mass & molar average velocities; shell mass balances; concentration distribution through stagnant gas, diffusion in heterogeneous and homogeneous chemical reaction, falling film; Equations of change for multicomponent systems and concentration distribution in turbulent flows; derivation of equation of continuity for binary mixture.

TEXTBOOK:

REFERENCES:

15CHE431  BIOCHEMICAL ENGINEERING  3 0 0 3
Unit 1
Introduction: History and need for biochemical Engineering; Essential life sciences: Biomolecules; Microbial world; Metabolism and Bioenergetics; Cell and their function; Enzymes and enzyme kinetics; Enzymes fundamental concepts, Classification of enzymes; Industrial application of enzymes; Industry important enzymes; Mechanism of enzymatic reactions; Kinetics: Michaelis-Menten and Briggs Haldane
equation; Evaluation of kinetic parameters; Enzymes inhibition; Factors affecting the reaction rates;

Unit 2
Immobile enzyme: Medical and analytical application of immobilized enzyme; Techniques; Immobilized Enzyme kinetics: Effect of mass transfer resistance. Microbial kinetics: Typical growth characteristics of microbial cells, factors affecting growth; Monod’s equation; Transport in microbial system: Newtonian and Non-Newtonian behavior of broths; Agitation and Mixing; Power consumption; Gas–Liquid transport in cells; Transfer resistances; Mass transfer coefficients and their role in scale-up of equipments.

Unit 3
Bioreactors: Batch and continuous types; High performance bioreactors; Downstream processes and effluent treatment: Recovery and purification of products, different unit operations in down streaming with special reference to membrane separations; Extractive fermentation; Anaerobic treatment of effluents; Typical industrial examples for downstream processing and effluent disposal.

TEXTBOOK:

REFERENCE BOOKS:

15CHE432 CHEMICAL PROCESS MODELING AND SIMULATION 3 0 0 3

Unit 1
Chemical engineering problems; Modeling – Steps involved; Variables – Stream, Unit, and Process variables; Constraints – Conservation relations, Sources and sinks, Material, Energy, Momentum balances; Equilibrium relations, Constitutive models; Common assumptions in modeling; Types of models – Lumped, Distributed, and Staged parameter models; Design variables – Characteristic length, time, velocity, temperature, mass, force; Change of variables; Dimensionless groups in modelling. Filling and draining tanks: Steady and unsteady states, Varying inlets and outlets, Level and flow control; Mixing tanks: Two and multiple streams, Composition control; Heated tank: Jacketed kettle with steam condensation, Electrical heating, Phase change; Isothermal CSTR: 1st and 2nd order reactions, Enzyme kinetics; Non-isothermal CSTR; Centrifugal separation.

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Unit 2
Shell balances: Flow through a pipe, Continuity equation; Compressible fluid flow, Shock waves; Double-pipe heat exchanger: Steam condensing in shell/tube, Parallel vs counter flow; Pipeline flashing; Isothermal PFR: Component continuity equation, 1st and 2nd order reactions; Non-isothermal PFR: 1st and 2nd order reaction. Triple effect evaporator; Binary distillation: continuous and batch columns; Multicomponent distillation: Underwood-Gilliland model; Gas absorption into a laminar liquid jet; Tray tower absorption: Kremser-Brown-Sauders equation, rigorous models; Reactive absorption in a wetted wall column; Multistage countercurrent liquid-liquid extraction.

Unit 3
Selected Systems from the following: Multiple steady states and Stability; Isothermal and Non-isothermal CSTR; Temperature control in a non-isothermal PFR; Packed bed reactor; Polymerization: Bulk and Suspension polymerization; Membrane separation – Cross flow and reverse osmosis; Activated sludge process – secondary bioreactor; Pyrolysis of plastic; Chemical vapor deposition; Continuous, multicomponent distillation column; Dry flue gas desulfurization; Ball mill; Rotary kiln.

TEXTBOOK / REFERENCE:

15CHE433 ENVIRONMENTAL ENGINEERING FOR PROCESS INDUSTRIES 3 0 0 3

Unit 1
SYLLABI

Pollution control in selected process industries – fertilizer industries, petroleum refineries and petrochemical units, pulp and paper industries, Tanning industries, Sugar industries, Dairy, Alcohol industries, Electroplating and metal finishing industries, Radioactive wastes, ranking of wastewater treatment alternatives, Case Studies.

Unit 2
Solid Wastes Management: Characterization of wastes-hazardous and non-hazardous wastes. Waste disposal and management laws and guidelines; Problems of collection and handling; various processing techniques used in solid waste management - treatment, disposal, utilization and management; value extraction from the wastes;

Industrial waste management and Pollution Prevention: Process modification, alternative raw material, recovery of by co-product, recycle and reuse of waste, energy recovery and waste utilization.

Unit 3
Air Pollution Control: Sources and effects of air pollutants on physical environment and living systems, Methods of measuring and sampling of gaseous and particulate pollutants, meteorological aspects of air pollution, effects, Selection and Design of particulate and gaseous pollution control equipment; mechanical separation, Bag filter, cyclone separator, electrostatic precipitation, wet gas scrubbing, adsorption and absorption.

TEXTBOOKS / REFERENCES:

15CHE434 INTERFACIAL SCIENCE AND ENGINEERING

Unit 1
Introduction – colloids, surfaces and interfaces, Colloids - classifications and characterizations. Colloids - preparation and purification methods - Surfaces and interfaces – definitions, description of different surface and interfaces, applications of interfacial engineering - Surface, interfacial tensions and measurement of interfacial tension using different methods - Surface properties.

Attractive forces and van der Waals interactions - Columbic forces and ionic, dipole interactions. Van der Waals forces in polar and non-polar media - Electrostatic and Electrokinetic theories.

Source of interfacial formation and electrical double layer (EDL) - Helmholtz model, Gouy-Chapmann model, Debye–Hückel theory on EDL, EDL thickness - Surface potential, Zeta potential, pH effects, calculations - Electroosmosis and Electrophoresis, types, applications.

Unit 2

Adsorption – Gibbs surface excess, adsorption equation for Solid-Fluid interfaces, Gibbs adsorption isotherm – Physisorptionvns Chemisorption, Thermodynamic considerations, heterogeneous catalysis.


Unit 3
Colloidal behaviour, Lennard–Jones 6–12 potential, attractive forces, sources of colloidal stability, critical coagulation concentration -Coagulation kinetics - fast and slow, Smoluchowski equation, DLVO theory, reversible flocculation.

Emulsions - formation, emulsification methods-Emulsifiers and Stabilizing agents, types, functions.

HLB number, PIT and Application of HLB and PIT in Emulsion Formulation - Association colloids - vesicles, micelles and membranes -Surfactant solubility, kraft temperature, and cloud point - Surfactant liquid crystals, micelles, micelle formation - Critical
micelle concentrations (CMC) - factors affecting CMC, additives - Vesicles and bilayer membranes – definitions, applications.

Optical properties - Light scattering, turbidity, light scattering theories - Scattering by small particles, large particles, Rayleigh, Debye and Mie scattering of particles - Foams, Aerosols, Foam stability and microfoams - Rheological properties of colloidal dispersions - viscosity, newtonian and non-newtonian fluids, Electroviscous effects.

REFERENCE / TEXTBOOKS:

15CHE435 MATERIAL CHARACTERIZATION AND SPECTROSCOPIC METHODS

Unit 1

Unit 2
X-ray-diffraction, properties of x-rays, review of crystal systems and miller indices, stereographic projections, Laue conditions, bragg's conditions, diffraction methods, phase identifications, electron diffraction methods.

Unit 3
EDAX, XPS, scattering methods, Thermal and Thermomechanical analysis: differential scanning calorimetry and Differential thermal analysis. Thermogravimetric analysis, Dynamic mechanical analysis and TMA.

REFERENCE / TEXTBOOKS:

15CHE436 MODERN SEPARATION METHODS

Unit 1
Introduction to binary distillation – The concept of K-factor; Multi-component distillation – Design, Models for multi-component design; Design of distillation columns for more than one feed stream; Pressure drop and tray-efficiency calculations.

Unit 2


Unit 3

REFERENCES:
7. Relevant journal publications.
Bottom-up approach: self-assemblies – hydrogen bonded, biomimetic and dimensional nanoparticle arrays.

Carbon nanomaterials - Carbon nanotubes and fullerenes: Formation and properties of nanotubes, fullerenes, characterizations and their applications in electronics and energy storage.

Molecular switches –monomolecular in solutions, on surfaces (electron, pH and light driven switches).

Unit 3
Micro/ Nanoelectronics (Nanowires: transistors, LEDs, Lasers, photodetectors).
Nano-Bio Technology (Lipid and lipid templates, selfassembled monolayers, biological computing, Protein Engineering, biosensors, drug delivery, PDT), Social implications of nanotechnology.

REFERENCE / TEXTBOOKS:

15CHE438 PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY

Unit 1

Unit 2
Petrochemical technology: Petrochemical industry overview, primary raw materials for petrochemicals, first generation petrochemicals – hydrocarbon intermediates and their production, non-hydrocarbon intermediates, olefin production, processing of olefins C4 & C5 cut from steam cracking and fluid cracking.

Unit 3

TEXTBOOKS:

REFERENCES:

15CHE439 POLYMER COMPOSITES

Unit 1

Unit 2
Fiber reinforced polymer composites (FRPs): Basic rule of mixtures, stress-strain relationships. Tailoring of structural properties through laminar-sequencing and choice of fiber fractions/fiber orientations, to meet design requirements. Effect of environmental conditions on properties. Mechanical behaviour of FRP composites: Fiber controlled and matrix dependent properties (tensile, compressive, shear). Experimental determination of composite properties by standard test methods. Composite constructions: Monolithic composite laminates; unidirectional and bidirectional, multi-axial, 3D, filament wound and braided types.
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### Unit 3
Composite precursors: SMCs, DMCs, BMCs prepreg materials and their choice in specific applications. Fabrication processes for FRP Composites: hand layup, spray up, vacuum bag moulding, compression moulding, filament winding, braiding, pultrusion, RTM, RIM, RFR, RI, autoclave moulding, injection moulding etc. Room temperature and hot curing of composites, Joining composite elements and repairs, Recycling of polymer composites.

**TEXTBOOKS:**

**REFERENCES:**

**15CHE440 POLYMERS MATERIALS - STRUCTURE 3 0 0 3 PROPERTY RELATIONS**

**Unit 1**
Structure of polymers – thermoplastic – thermoset, rubber - Linear, branched, crosslinked, and network polymers - Homochain and hetero atomic chain polymers - Copolymers - Linear and cyclic arrangement - Prediction of polymer properties, group contribution techniques, topological techniques - Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.

Mechanical properties - Stress-strain properties of polymers - Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness - Crazing in glassy polymers - Ductile brittle transition. Effect of additives on mechanical properties of polymers - Creep, stress relaxation, and fatigue.

**Unit 2**
Thermodynamic and transition properties - Transition temperature in polymers, glass transition (Tg), melt transition (Tm), relationship between Tg and Tm - other transitions like 8-transitions, upper and lower glass transition temperatures - Prediction of Tg and Tm of polymers by group contributions.Calorimetric properties - Heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy - Calculation of heat capacities of polymers.

Electrical and optical properties - Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor - effect of frequency of voltage and temperature on dielectric properties - Prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers.

**Unit 3**
Optical properties - Effect of polymer structure on optical properties - clarity, transparency, haze, transmittance, reflectance, and gloss - Prediction of refractive indices of polymers by group contributions.

Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers - Prediction of solubility parameter - Effect of polymer structure on solubility in solvents and oils - Influence of structure in prediction of flame retardancy, water repellency - Chemical resistance of polymers - Polymer toxicity.

**TEXTBOOKS:**

**REFERENCE BOOKS:**

**15CHE441 POLYMER PROCESSING 3 0 0 3**

**Unit 1**

**Unit 2**
Unit 3

TEXTBOOKS:

REFERENCES:

15CHE442 PROCESS INSTRUMENTATION 3 0 0 3

Unit 1
Introduction, general principles of measurement, classification of instruments, elements of an instrument, direct and inferential measurement; Static and dynamic characteristics of instruments, errors in measurements & error Analysis; Classification of sensors and transducers, amplifier signal conditioner, signal isolation, transmission, display, data acquisition modules, interfaces, recording, Control centre, instrumentation diagram.

Temperature measurement: Expansion thermometers - constant-volume gas thermometer, pressure spring thermometer, volumetric and pressure thermometers; Thermoelectric temperature measurement - Thermoelectricity, industrial thermocouples; Resistance thermometers - industrial resistance thermometers, null-bridge resistance thermometers, deflectional resistance thermometers; Radiation temperature measurement - radiation pyrometers, photoelectric pyrometers and optical pyrometers.

Unit 2
Measurement of pressure and vacuum: Pressure, vacuum and head; liquid column manometers - U-tube type, well type and inclined type, micromanometers; Low pressure measurement - kenetometer, McLeod gage, thermal conductivity gauge; Barometer method for atmospheric pressure measurement; pressure measurement using bourdon tube, flat and corrugated diaphragms, and capsules; Measurement of pressure in corrosive fluids using liquid seal and diaphragm seal.

TEXTBOOK:
1. Jain R. K., Mechanical and Industrial Measurements, Khanna

REFERENCES:

15CHE443 PROCESS INTENSIFICATION 3 0 0 3

Unit 1

Unit 2
Intensified Reactors: Spinning Disk Reactors; Oscillatory Baffled Reactors; Taylor-Couette Flow Reactor Microreactors: Basics & Applications; HEX Reactors; Induction
Unit 3
Reactive Separations: Reactive Distillation and Reactive Extraction; Membrane Reactors - Applications to dehydrogenation; Steam-methane reformation;

Case studies: Reaction separation of Plastic/Biomass pyrolysis; Petrochemicals and Fine Chemicals, Refineries, Bulk Chemicals, & Nuclear Industry.

**TEXTBOOK / REFERENCES:**

**15CHE444 SAFETY AND HAZARD MANAGEMENT IN CHEMICAL INDUSTRIES**

**Unit 1**
Hazard identification: General hazards of plant operation toxic hazards, fire and explosions – hazards. Transport of chemicals with safety unforeseen deviations, emergency management, planning for safety, selecting a basics of safety – preventive and protective measures, safety based on emergency, relief systems, safety based on containment operational safety procedural instructions – routine checks, process and product changes, safety checks, checklist for safety, leaks and detection.

**Unit 2**
Hazard of plant operation: Toxic hazards, fire and explosion hazards, reaction hazards, literature calculations & explosions screening, normal reaction, gas evolution, characterizing runaway, control and mitigation of gas emanations, absorption with chemical reaction, health and environmental effects. Special problem of developing countries, safety gadgets, dispersions, degree of hazards, disposals, hierarchy of options, threshold limits, laws of safety, accident reporting.

**TEXTBOOKS:**

**REFERENCES:**

**15CHE445 SOLAR ENERGY**

**Unit 1**
Solar radiation, its measurements and analysis. Solar angles, day length, angle of incidence on tilted surface, Sunpath diagrams, Shadow determination. Extraterrestrial characteristics, Effect of earth atmosphere, measurement & estimation on horizontal and tilted surfaces.

Solar cell physics
p-n junction, homo and hetero junctions, Metal-semiconductor interface, Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, efficiency measurements, high efficiency cells, Tandem structure.

**Unit 2**
Solar cell fabrication technology
Preparation of metallurgical, Electronic and Solar grade Silicon, Production of Single Crystal ‘Si’, Choccharlski (CZ) and Float Zone (FZ) method for preparation of silicon, procedure of masking, photolithography and etching, Design of a complete silicon, GaAs, InP solar cell. High efficiency III-V, II-VI multijunction solar cell, a-Si-H based solar cells, Quantum well solar cell, Thermophotovoltaics. Nanosolar cells. Thin film technologies.
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Solar Cell Characterization
Characterization of solar cells: IV characteristics, impedance, incident photon-to-current conversion efficiency (IPCE), intensity modulated photovoltage spectroscopy (IMPS), lifetime measurements.

Solar photovoltaic system design
Solar cell arrays, system analysis and performance prediction, shadow analysis, reliability, solar cell array design concepts, PV system design, Design process and optimization, Detailed array design, storage autonomy, Voltage regulation, maximum tracking, Power electronic converters for interfacing with load and grid, use of computers in array design, Quick sizing method, Array protection and troubleshooting.

Unit 3
Emerging Photovoltaic Technologies
Working principle, characterization and applications of: organic solar cells, dye sensitized solar cells, quantum dot solar cells, bulk heterojunction solar cells

SPV applications
Centralized and decentralized SPV systems, stand alone, hybrid and grid connected systems, system installation, operation and maintenances, case studies and field experience, PV market analysis and Economics of SPV systems.

TEXTBOOKS:
1. John W Twidell and A D Weir, Renewable Energy Resources, ELBS

REFERENCE BOOKS:

15CHE470  FUNDAMENTALS OF MANAGEMENT  3 0 0 3

Unit 1
Introduction - Managers and Management. The historical roots of contemporary management practices - the pre-modern era, classical contributions, human resources approach, the quantitative approach. The Management Environment - A global market place, emphasis on technology, society and managers, entrepreneurship.

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Foundations of Planning - Planning in uncertain environments, types of plans, management by objectives. The importance of organizational strategy, strategic framework, quality as a Strategic weapon. Foundations of Decision Making - The decision-making process, making decisions - the rational model, modifications of the rational model. Decision making - a contingency approach, decision-making styles, making decisions in groups.

Unit 2
Basic Organization Designs - The elements of structure, contingency variables affecting structure, organization design applications, learning organization, organization culture.

Managers and the Human resource management process - Employment planning, recruitment and selection, orientation, training, and development, performance management, compensation and benefits, managing change, stress and innovation, change process, organizational change and member resistance, making changes in the organization. Stress - the aftermath of organizational change, stimulating innovation.

Unit 3
Foundations of Individual and Group behaviour - Explaining and predicting behaviour, personality, perception, learning, foundations of group behaviour. Understanding work teams - types of work teams, characteristics of high-performance work teams. Motivating and rewarding employees - motivation and individual needs, early theories of motivation, contemporary theories of motivation. Leadership and Trust - Managers versus leaders, trait theories of leadership, behavioral theories of leadership, contingency theories of leadership, emerging approaches to leadership, contemporary leadership issues, building trust. Communication and Interpersonal skills - understanding communication, communication and Information Technology, developing interpersonal skills.

Foundations of Control - the importance of control, types of control, control implications for managers, the dysfunctional side of control.

TEXTBOOK:

15CHE471  MANAGERIAL ECONOMICS AND ACCOUNTING  3 0 0 3

Unit 1
Introduction to Economics and managerial Decision Making, the Economics of a business, a brief review of important economic terms and concepts; Supply and
Demand - market demand, market supply, determinants of supply and demand, short run market changes and long run market analysis, comparative statics analysis, Demand Elasticity - the economic concept of elasticity, the price elasticity of demand, the cross-elasticity of demand, income elasticity, other elasticity measures, elasticity and total revenue; Elasticity of Supply. Applications of elasticity. Marginal utility, the law of diminishing marginal utility.

The theory and estimation of production - the production function, a short-run analysis of total, average, and marginal product, the three stages of production in the short run, long run and the law of diminishing returns, derived demand and the optimal level of variable input usage. Forms of production function.

Unit 2
The Theory and Estimation of Cost - the importance of Cost in managerial decisions, the relationship between production and cost, the short-run cost function, the long-run cost function, economies of scale.

Pricing and output decisions - Competition and market types, pricing and output decisions in perfect competition, selecting optimum output level, competitive market in the long run; Pricing and output decisions in monopoly markets, implications for managerial decision making. Pricing and output decisions in monopolistic competition; oligopoly and market concentration, pricing in oligopolistic market.

Unit 3
Management accounting: Balance Sheet and Profit and Loss account – financial statements, assets, liabilities, and owner’s equity, relationship between assets, liabilities and owner’s equity, forms of the balance sheet, profit and loss account, relation between balance sheet and profit and loss account. Cost classifications and allocation - nature of cost, historical and future costs, cost classifications in a manufacturing firm, cost concepts for planning and control, cost allocation; cost-volume-profit analysis and operating leverage; Break-even analysis, break-even point, operative leverage.

Capital expenditure planning - nature of investment decisions, investment evaluation criteria, time value of money, net present value method, internal rate of return method, profitability index, payback period, accounting rate of return method, cash flows for investment analysis. Capital budgeting process.


REFERENCE BOOKS
characteristics. Study of control systems involving temperature, pressure, flow and level, Study advanced control strategies and Controller tuning.

15CHE482  COMPUTER AIDED DESIGN OF CHEMICAL PROCESS LAB.

Introduction to Aspen PLUS/ HYSYS; Thermodynamic property methods; Solution strategies; Simulation of pressure changing devices (Pumps, Compressors and Turbine); Simulation of two-phase and three phase separation units, Simulation of heat exchangers, Simulation of reactors (Plug Flow, Mixed Flow, Conversion, Gibbs, Equilibrium reactors and their combinations); Simulation of Distillation, Absorption and Extraction columns;

Case study set up and Sensitivity analysis.

15CHE495  PROJECT PHASE I  2 cr

Identification of the problem based on the current need gaps of the industry / knowledge / other academic / theoretical aspects; literature survey, identification of the project deliverables, identification of materials / equipment requirements, preparation of the methodology for the experimentation, and procurement of the materials. Presentation of project progress report to the department for evaluation at the end of the semester.

15CHE499  PROJECT PHASE II  10 cr

Setting up of the experimental work (hardware/software), carrying out the experimental work, carrying out material characterization if required, analysis of the results, discussion and interpretation of the results, validation of the hypothesis, and reporting project outcome in the approvedformat.

Presentation of the work / findings to the faculty for review and feedback three times during the semester. The final project will be evaluated by expert panel consisting of internal and external examiners.

15CHY100  CHEMISTRY  3 0 0 3

Unit 1

Chemical Bonding

Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties. Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing power, polaribility of ions and Fajan’s rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules - co-ordinate covalent compounds and their characteristics, molecular orbital theory for H2, N2, O2 and CO2, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2

Thermodynamic Parameters

Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthalpy, entropy and free changes - spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff’ relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Kinetics

Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations - mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics-enzyme catalysis.

Unit 3

Electrochemistry

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday’s laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nerst equation and its application, reference electrodes - SHE, Ag/AgCl, Calomel.

Photochemistry

Photochemistry, laws of photochemistry - Stark-Einstein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photo polymerization.

REFERENCE BOOKS

Physical chemistry, Puri and Sharma
Inorganic chemistry, Puri and Sharma
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2015 admissions onwards

15CHY181  CHEMISTRY LAB.  0 0 2 1

1. Acid base titration (double titration)
2. Complexometric titration (double titration)
3. Redox (permanganometry) titration (double titration)
4. Conductometric titration
5. Potentiometric titration
6. Ester hydrolysis

15CHY231  ADVANCED POLYMER CHEMISTRY  3 0 0 3

Unit 1

Unit 2
Solid-state irradiation polymerization - Atom transfer radical polymerization - Plasma Polymerization - Zwitterionic Polymerization - Isomerization polymerization - Polymer supported solid phase reactions - Merrifield method.

Polymer degradation and stabilization: Mechanism of different types of degradation - Commonly used antidegradants and the mechanism of their stabilization.

Unit 3

TEXTBOOKS:
3. Jayadev Sreedhar and Govariker, “Polymer Chemistry”.

15CHY232  BIOMATERIALS SCIENCE  3 0 0 3

Unit 1
Introduction: Bulk properties, Surface properties and characterization - polymers, silicone biomaterials, medical fibres and biotextiles - Smart polymers - bioreversible and biodegradable materials - natural materials, metals and ceramics - physicochemical surface modification.

Biocompatibility concepts: Introduction to biocompatibility - cell material interaction - types of materials - toxic, inert, bioactive - long term effects of materials within the body - cell response.

Unit 2
Chemical and biochemical degradation of polymers - degradation of metals and ceramics - calcification of biomaterials.

Host reactions and their evaluation: Inflammation and foreign body response - adaptive immunity - systemic toxicity and hypersensitivity - blood coagulation and blood materials interactions - device related infections.

Unit 3
Biological testing of biomaterials: Invitro and invivo assessment of tissue compatibility - evaluation of blood materials interaction - microscopy in biomaterials.

Practical aspects of biomaterials: Bioelectrodes, biomedical sensors and biosensors - sterilization of implants - implant failure - implant retrieval and evaluation - legal aspects, ethical issues and regulation aspects.

TEXTBOOK:

REFERENCES:
15CHY233 CATALYTIC CHEMISTRY 3 0 0 3

Unit 1
Catalysis: Introduction, Industrial applications. Rates of reactions - equilibrium, energy of activation and the catalyst's role, Elementary reactions in catalytic transformations homogeneous and heterogeneous catalysis.

Catalysis in solutions: Acid-base catalysis - catalysis in the gas phase, catalysis in dilute aqueous solution, catalysis in concentrated strong acid solutions, catalysis by bases, catalysis by metal ions, catalysis by electron transfer, organometallic catalysis, catalysis in Ziegler Natta/Metallocene/Metathesis polymerization.

Unit 2
Catalysis by macromolecules, Phase transfer catalysis.

Catalysis by Enzymes: Introduction - kinetics of enzyme catalyzed reaction, catalysis through enzyme, organic catalysis, metalloenzyme catalysis, supported enzymes. Industrial applications of enzyme catalyst.

Catalysis by Polymers: Attachment of catalytic groups to polymer supports, Adsorption and the Kinetics of polymer-catalyzed reactions.

Unit 3
Catalysis in polymer gels, bifunctional and multifunctional catalysis, porous polymers, Applications of polymer catalysis.


TEXTBOOKS:

REFERENCES:

15CHY234 CHEMISTRY OF ADVANCED MATERIALS 3 0 0 3

Unit 1
Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, polycarbonates, epoxy resins - polyamides - Nylon and Kevlar.

CHEMISTRY OF ENGINEERING MATERIALS 3 0 0 3

Unit 1
Chemical materials in Electronics and Electrical Engineering: Structural correlation to behavior of conducting polymers, Semi-conducting polymers - properties of organic polymers containing metal groups such as poly ferrocene - optical fibers - definition, principle and structure - characteristics of optical fibre - photo resist


Unit 2

Chemistry of Engineering Plastics: Preparation, properties and applications of ABS, Polycarbonates, Epoxy resins - Polyamides - Nylon and Kevlar.

Photochemistry in Electronics: Photochemical reactions - laws of absorption (Grothers-Draper law - Stark-Einstein's law) - Quantum efficiency - photochemical decomposition of HI and HBr - and Quantum yield.

Unit 3
Florescence and Phosphorescence - chemiluminescence - photo sensitization.


TEXTBOOK:

REFERENCES:

SYLLABI
B. Tech - Chemical Engg. 2015 admissions onwards

15CHY236 CHEMISTRY OF NANOMATERIALS 3 0 0 3

Unit 1
Introduction: Introduction to Nanomaterials: Size dependence of properties - Surface to volume ratio and Quantum confinement. Microscopic techniques to study nanostructures - SEM, AFM - TEM and STM - Raman spectroscopy.

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Synthesis of Nanomaterials: Synthetic approaches: Colloidal Self-Assembly (Self-assembled monolayers - SAMs) and electrostatic self-assembly, electrochemical methods, sol-gel deposition.

Unit 2
Langmuir-Blodgett (LB) technique, chemical vapour deposition, plasma arcing and ball milling.

Carbon nanostructures: Carbon Clusters: Fullerenes, structure, synthesis, alkali doped C60 - superconductivity in C60, applications of fullerenes. Carbon nanotubes: Classification, properties, synthesis, characterization, and potential applications, growth mechanism of carbon nanotubes.

Other Nanostructures: Quantum Dots: Preparation, properties and applications of Au, CdS and CdSe quantum dots.

Unit 3
Fabrication and applications of conducting polymer nanotubes, TiO2 and metallic nanotubes.

Molecular Electronics and Machines: Molecular electronics: Working of Molecular and supramolecular switches, transistors and wires. Molecular machines: Working of Molecular motors, rotors, cars, elevators and valves.

TEXTBOOKS:

REFERENCES:
15CHY237 CHEMISTRY OF TOXICOLOGY  3 0 0 3

Unit 1
Introduction to Toxicology: Definition - scope - history - relationship to other sciences - dose-response relationship - sources of toxic compounds - Classes of Toxicants - broad overview of toxicant classes such as metals, agricultural chemicals, food additives - contaminants, toxins, solvents, drugs, and cosmetics - history, exposure route, and toxicity of the non-essential metals - cadmium, lead, and mercury - medical treatment of metal poisoning - classes of agricultural chemicals - Toxins - source, including microbial, fungal, algal, plant and animal - examples - Brief discussions - food additives and contaminants – solvents - therapeutic drugs - drugs of abuse - combustion products - cosmetics.

Unit 2
Exposure Classes, Toxicants in Air, Water, Soil, Domestic and Settings: Occupational Air, water and soil as primary media for human exposure to various classes of chemical toxicants in environmental, domestic, and occupational settings - historic and present status of air pollution and air quality - introduction to the major classes of soil and water pollutants - sources, exposure routes and potential adverse health effects - Classes of occupational toxicants - route of exposure and permissible levels - specific examples of concern.

Unit 3
Toxicant Analysis and Quality Assurance Principles: Introduction to procedures, principles and operation of analytical laboratories in toxicology. Summary of the general policies - analytical laboratory operation, analytical measurement systems, quality assurance (QA) - quality control (QC) procedures.


TEXTBOOK:

REFERENCES:

15CHY238 COLLOIDAL AND INTERFACIAL CHEMISTRY  3 0 0 3

Unit 1
Introduction to surfaces, interfaces and colloids: Molecular origin, Surface phenomena and structure of interfaces, Surfactants structure, colloids in action - shapes and size distribution, Types of interaction forces - Physical and Chemical interaction, Classification of physical forces - Vander Waals force, electrostatic forces.


Unit 2
Interfaces between Condensed Phases - Wetting, The interfaces between condensed phases in two-component systems, Adsorption at interfaces between condensed phases.

Thermodynamics - Adsorption, energy consideration of physical adsorption vs chemisorptions, Gibbs adsorption equation, Langmuir isotherm, BET isotherm, adsorption at solid-liquid interfaces. Emulsions - formation and stability, HLB number, PIT (Phase Inversion Temperature) foams, aerosols, Microemulsions, vesicles, micelles and membranes - applications of various colloidal systems.

Unit 3
Characterization of Colloids, Rheological properties - Classification, Interfacial rheology, Interfacial tension, Electrochemistry of interfaces - Electric double layer.

Stability of charge stabilized colloids, DLVO theory, Hamaker constant, Boltzmann distribution, Debye length, specific ion adsorption, Stern layer, electrostatic, steric and electrosteric stabilization, zeta potential, surface tension, wetting and spreading, contact angle - Young’s modulus, practical application - solid surfaces - surface mobility, characteristics and formation.

TEXTBOOKS:

REFERENCES:
2. J. W. Goodwin, “Colloids and Interfaces with Surfactants and Polymers”, John-Wiley and Sons Ltd, 2004
Schools of Engineering
Amrita Vishwa Vidyapeetham

15CHY239 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING

Unit 1
Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.


Introduction to Quantum mechanics - Schrodinger equation - Position and momentum - MO formation - Operators and the Hamiltonian operator - The quantum oscillator - Oscillator Eigen value problems - Quantum numbers - labeling of atomic electrons.

Unit 2
Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel’s MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel’s theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel’s coefficient matrix - Wheeland’s method - Hoffmann’s EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3
Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman's theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes - Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

TEXTBOOKS:

REFERENCES:

15CHY241 ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES

Unit 1
Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2
Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.
Unit 3

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

REFERENCES:

15CHY242 ENVIRONMENTAL CHEMISTRY

Unit 1
Air and air pollution (earth’s atmosphere): Regions - ozone - CFC and other chemicals - catalytic decomposition of ozone - ‘ozone hole’ formation - Air pollution due to gas emission from industries - Atmospheric aerosols – dust, combustion products, aerosol concentration and lifetimes - Automobile exhausts, smog and effects - Acid rain - chemistry of acid rain, roll of meteorology, greenhouse gases and global warming - air pollution due to jet engines.


REFERENCES:
15CHY243  FUELS AND COMBUSTION  3 0 0 3

Unit 1
Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.


Unit 2
Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

TEXTBOOK:

REFERENCE:

15CHY244  GREEN CHEMISTRY AND TECHNOLOGY  3 0 0 3

Unit 1
Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2
Greener strategies of the synthesis of ibuprofen synthesis, teripthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3
Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:
1. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.

15CHY245  INSTRUMENTAL METHODS OF ANALYSIS  3 0 0 3

Unit 1

Separation Techniques: Brief out line of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.
Unit 2
Gas chromatography - principle and applications – gel chromatography.


Unit 3

Thermal and Diffraction techniques: Principles and applications of DTG - DTA - DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

TEXTBOOKS:

REFERENCES:

15CHY247 MODERN POLYMER COMPOSITES 3 0 0 3

Unit 1

Unit 2
Unit 3
Composite precursors: SMCs, DMCs, BMCs prepreg materials and their choice in specific applications. Fabrication processes for FRP Composites: hand layup, spray up, vacuum bag moulding, compression moulding, filament winding, braiding, pultrusion, RTM, RIM, RRIM, RFI, autoclave moulding, injection moulding etc. Room temperature and hot curing of composites. Nanocomposites: Introduction; Nanoscale Fillers – Clay, POSS, CNT, nanoparticle fillers; Processing into nanocomposites; Modification of interfaces; Properties. Applications. Joining composite elements and repairs, Recycling of polymer composites.

TEXTBOOKS:

REFERENCES

15CHY248 ORGANIC REACTION MECHANISMS 3 0 0 3

Unit 1
Introduction to organic chemistry: Lewis structure and formal charges of organic compounds - electro negativities and dipoles, resonances, aromaticity and anti aromaticity - equilibrium, tautomerism and hyper conjugation - acidity and basicity - pKa, nucleophiles and electrophiles - hydrogen bonding - different types of organic reaction - addition, substitution, elimination and rearrangement - oxidations and reductions - general principles of writing organic reaction mechanism - reactive intermediates.

Reaction of nucleophiles and bases: Nucleophilic substitution - SN1 and SN2 reactions, nucleophilic substitution at aliphatic sp2 carbon and aromatic carbon - nucleophilic addition to carbonyl compounds - addition of grignard and organo lithium reagents - reactions of nitrogen containing nucleophiles with aldehyde and ketones - aldol condensation.

Unit 2
Michael and 1,4-addition reaction - Favoriski rearrangement - benzilic acid rearrangement - reaction mechanism in basic media - Mannich reaction - enols and enolates.

Reaction involving acids and other electrophiles: Carbocations - formation and rearrangements - cationic rearrangement involving electron deficient nitrogen atom - Beckmann rearrangement - Curtius, Lossen and Schmidt rearrangement - electrophilic additions - acid catalyzed reaction of carbonyl compounds - hydrolysis of carbocyclic acid derivatives - electrophilic aromatic substitution - carbenes and benzynes - Baeeyer-Villeger reactions - Dienone-phenol rearrangement - pinacol rearrangement.

Unit 3
Radical and radical ions: Formation of radicals, radical chain processes, radical addition, reaction with and without cyclisation - fragmentation reaction - rearrangement of radicals - SRN 1 reaction - radical ions - Birch reduction - Hofmann-Loffler-Freytag reaction - Barton reaction - McMurry reaction.


TEXTBOOK:

REFERENCES:

15CHY249 ORGANIC SYNTHESIS AND STEREOCHEMISTRY 3 0 0 3

Unit 1
Nomenclature of Organic compounds: Polyenes, Alkynes with and without functional groups by IUPAC nomenclature. Aromatic and Heteroaromatic systems - nomenclature of heterocycles having not more than two hetero atoms such as oxygen, sulphur, nitrogen.

Stereochemistry: Tactility, R/S system of nomenclature of central and axial molecules.

Unit 2
Atropisomerism - isomerism of biphenyls - allenes and spiranes - ansa compounds - Geometrical isomerism, E, Z Isomerism. Asymmetric synthesis.

Conformational Analysis: Optical activity and chirality - Conformational Analysis of cyclic and acyclic system - Conformational effects on reactivity of acyclic systems only.
Unit 3

TEXTBOOKS:

REFERENCES:

15CHY250 POLYMER MATERIALS AND PROPERTIES 3 0 0 3

Unit 1

Unit 2
Manufacturing, mechanical, thermal, electrical and chemical properties and applications of commodity plastics - PE, PP, PVC, PS, Engineering plastics - ABS, PC, PMMA, polyamide, polyacetal, PET, PBT, PTFE, High performance polymer - PES, PEI, PEEK, conducting polymer.

Unit 3
Thermoset materials - PF, UF, MF, epoxy and unsaturated polyester resin, Rubber - natural rubber, synthetic rubber - SBR, PB, nitrile, chloroprene, butyl, silicone - compounding and additives.

TEXTBOOKS:

REFERENCE BOOKS:


15CHY251 POLYMERS FOR ELECTRONICS 3 0 0 3

Unit 1

Unit 2
Photoconductive polymers: Charge carriers, charge injectors, charge transport, charge trapping. Polymers for optical data storage - principles of optical storage, polymers in recording layer.

Nonlinear optics: NLO properties and NLO effects, wave guide devices, polymer optical fibers - through plane modulators.

Unit 3

Liquid crystalline polymers: Fundamentals and process, liquid crystalline displays - Applications.

TEXTBOOK:

REFERENCES:

15CHY252 SOLID STATE CHEMISTRY 3 0 0 3

Unit 1
Symmetry in Crystal Systems: Types of symmetry, plane, axis and centre of symmetry, crystal systems and symmetry elements. Law of rational indices, Miller indices, Weiss indices - plane systems, space lattices, unitcells - unitcell dimension,
determination. Space lattice - definition and types Bravais lattice - kinds of bravais lattices, number of atoms in SC, BCC, FCC lattices, void space, Radius ratio rule and application. Crystal defects - types of defects in crystals - stoichiometric defect - schottky and frenkel defects - Non-stoichiometric defects - metal excess and metal deficiency defects, influence of defects on the properties of solids.

Unit 2
Electrical and Magnetic Properties: Development of free electron theory to band theory of solids - metals and their properties; semiconductors - extrinsic and intrinsic, Hall effect; Insulators - dielectric, ferroelectric, piezoelectric and peizolectric properties and the relationship between them. Dia, para, ferro, ferri, antiferro and antiferri magnetic types - selected magnetic materials such as spinels, garnets and perovskites, superconductors.


Unit 3

Fourier synthesis - definition, applications of fourier synthesis in crystal structure analysis of S-Tetrazine. Structure of Rutile, Fluorite, Antifluorite, Zinc blende, Wurtzite, diamond and graphite.

REFERENCES:
SYLLABI  B. Tech - Chemical Engg.  2015 admissions onwards

REFERENCES:

15CHY332  CORROSION SCIENCE  3 0 0 3

Unit 1
Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2
Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes - Arc spray - Plasma spray - Flame spray.

Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3
Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.


TEXTBOOKS:

REFERENCES:

SYLLABI  B. Tech - Chemical Engg.  2015 admissions onwards

15CSE100  COMPUTATIONAL THINKING AND PROBLEM SOLVING  3 0 2 4

Unit 1

Unit 2

Unit 3
Problem Solving Techniques: Factoring and Recursion Techniques, Search and Sort techniques, Text processing and Pattern matching.

TEXTBOOKS:
2. R. G. Dromey, “How to solve it by Computer”, PHI, 2008

15CSE102  COMPUTER PROGRAMMING  3 0 0 3

Unit 1
Introduction to C language: Structure of a C program, comments, Data types, Variables, constants, Data input and output statements, input assertions; expressions and evaluation. Functions: inter function communication, standard functions, scope. Selection: two way selection, multi-way selection, repetition: concept of loop, loop invariant, pretest and post-test loops, initialization and updating, event and counter controlled loops. Recursion: recursive definition, recursive solution, designing recursive functions, limitations of recursion.

Unit 2

Unit 3
Strings: fixed length and variable length strings, strings and characters, string input output, array of strings, string manipulation functions, sorting of strings. Enumerated types, Structures: Structure vs array comparison, complex structures, Structures and functions, Union, binary input output, Command line arguments.
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**TEXTBOOK:**

**REFERENCES:**

**15CSE180 COMPUTER PROGRAMMING LAB. 0 0 2 1**

Solving simple problems with operators, programs on conditional control constructs, programs on loops (while, do-while, for), programs using user defined functions and library functions, programs on Files, arrays, matrices (single and multi-dimensional arrays), programs using DMA, programs on strings, structures.

**REFERENCE:**

**15CUL101 CULTURAL EDUCATION I 2 0 0 2**

Unit 1
Introduction to Indian Culture; Introduction to Amma’s Life and Teachings; Symbols of Indian Culture.

Unit 2
Science and Technology in ancient India; Education in Ancient India; Goals of Life - Purusharthas; Introduction to Vendanta and Bhagavat Gita.

Unit 3
Introduction to Yoga; Nature and Indian Culture; Values from Indian History; Life and work of Great Seers of India.

**TEXTBOOKS:**
1. The Glory of India (in-house publication)
2. The Mother of Sweet Bliss (Amma’s Life & Teachings)

**15CUL111 CULTURAL EDUCATION II 2 0 0 2**

Unit 1
1. Relevance of Sri Rama and Sri Krishna in this Scientific Age

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**15CUL230 ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE 2 0 0 2**

**OBJECTIVES:** The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.

Unit 1
Goals of Life – Purusharthas
What are Purusharthas (Dharma, Artha, Kama, Moksha)? Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;

Yogic way of Achieving Life Goals – (Stress Free & Focused Life)
Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop);

Experiencing life through its Various Stages
Ashram Dharma; Attitude towards life through its various stages (Teachings of Amma);

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Unit 2
Personality Development
What is Personality – Five Dimensions – PanchaKosas (Physical / Energy / Mental / Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;

Learning Skills (Teachings of Amma)
Art of Relaxed Learning; Art of Listening; Developing ‘Shraddha’ – a basic qualification for obtaining Knowledge;

Communication Skills - An Indian Perspective;

Unit 3
Developing Positive Attitude & Friendliness - (Vedic Perspective);

Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);

Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);

REFERENCE BOOKS:
1. Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9
2. Complete works of Swami Vivekananda (Volumes 1 to 9)
3. Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)
4. Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Vol.s1 to 3)
8. Will Power and its Development- Swami Budhananda published by Advaitha Ashram, Kolkatta
10. Yoga in Daily Life - Swami Sivananda – published by Divine Life Society
12. All about Hinduism – Swami Sivananda - Published by Divine Life Society
15. Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi
17. Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.

Unit 1
1. The anatomy of ‘Excellence’. What is ‘excellence’? Is it judged by external factors like wealth?
2. The Great Flaw. The subject-object relationship between individual and world.
3. To work towards excellence, one must know where he is. Our present state...

Unit 2
5. The play of the mind. Emotions – convert weakness into strength.
6. The indispensible role of the intellect. How to achieve and apply clear thinking?
8. Increase Productivity, reduce stress.. work patterning.

REFERENCES:
The Bhaja Govindam and the Bhagavad Gita.

Unit 3
8. The art of right contact with the world.assessment, expectations.
9. Myths and Realities on key issues like richness, wisdom, spirituality.
10. Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:
The Bhaja Govindam and the Bhagavad Gita.

15CUL232 EXPLORING SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

OBJECTIVES: This course offers a journey of exploration through the early developments in India of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as well as actual techniques.

Unit 1
1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanta Jyotish and the first Indian calendars;
5. Sulba Sutras and the foundations of Indian geometry;
Unit 2
6. Astronomy & mathematics in Jain and Buddhist literature;
7. The transition to the Siddhantic period; Aryabhata and his time;
8. The Aryabhatiya: concepts, content, commentaries;
9. Brahmagupta and his advances;
10. Other great Siddhantic savants;
11. Bhaskara II and his advances;

Unit 3
12. The Kerala school of mathematics;
13. The Kerala school of astronomy;
14. Did Indian science die out?;
15. Overview of recent Indian scientists, from S. Ramanujan onward;
16. Conclusion: assessment and discussion;

TEXTBOOK:
Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE:
IFIH's interactive multimedia DVD on Science & Technology in Ancient India.

15CUL233  YOGA PSYCHOLOGY  2 0 0 2

OBJECTIVES: This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.

Unit 1
Introduction
Introduction to Modern Psychology
A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in Western Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology
What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga-schools.

Patanjali Yoga Sutra – 1

Patanjali Yoga Sutra – 2

Patanjali Yoga Sutra – 3
Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4

Patanjali Yoga Sutra – 5
Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.

Patanjali Yoga Sutra – 6

Patanjali Yoga Sutra – 7

Patanjali Yoga Sutra – 8

Patanjali Yoga Sutra – 9

Patanjali Yoga Sutra – 10
Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses.

Report review
Conclusion

REFERENCES:
• The course book will be “The four chapters of Freedom” written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.
• “The message of Upanishads” written by Swami Ranganathananda. Published by Bharathiya Vidya Bhavan.
• Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttarajal.
• ‘Hatha Yoga Pradipika’ Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India

15EEE180 WORKSHOP B 0 0 2 1

Part A - Electronics
Identification of electronic components (Passive and Active)
Study of measuring instruments (Voltmeter, Ammeter and Multimeter)
Measurement and theoretical Verification of series and parallel combination of resistors and capacitors
Calibration of CRO and measurements of signal parameters (RMS, maximum value, peak value, time and frequency)
Calibration of function generator using CRO
Soldering practice

Part B - Electrical
1. Study on power supply and protective devices
2. Study on tools and electrical accessories
3. Study on sources of light
4. Study on energy efficiency
5. Study on water pump
6. Study on house hold appliances:
   a. Iron box
   b. Fan
   c. Refrigerator
   d. Air conditioner
7. House wiring I – Glow an incandescent lamp using SPST switch
8. House wiring II – Glow a fluorescent lamp using SPST switch
9. House wiring III – Operate a fan and an incandescent lamp using two independent SPST switch
10. House wiring IV – Operate a fluorescent lamp and a 3 pin socket using two independent SPST switch
11. House wiring V – Staircase wiring
12. House wiring VI – Godown wiring

15ENG111 COMMUNICATIVE ENGLISH 2 0 2 3

OBJECTIVES: To make the students communicate their thoughts, opinions, and ideas freely and naturally; to make them understand the different styles in communication; to make the students understand the aesthetics of reading and writing; to bring in a spirit of enquiry; to motivate critical thinking and analysis; to help them ruminate on human values.

15ENG230 BUSINESS COMMUNICATION 1 0 2 2

OBJECTIVES: To introduce business vocabulary; to introduce business style in writing and speaking; to expose students to the cross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation in business contexts.

Unit 1
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Unit 2
Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3
Active Listening: Pronunciation – information gathering and reporting - Speaking: Cross-Cultural Issues, Group Dynamics, negotiation & persuasion techniques.

Activities
Case studies & role-plays.

BOOKS RECOMMENDED:

15ENG231 INDIAN THOUGHT THROUGH ENGLISH

OBJECTIVES: To expose the students to the greatness of Indian Thought in English; to develop a sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about the societal changes in the recent past.

Unit 1 Poems
Rabindranath Tagore's Gitanjali (1-10); Nizzim Ezekiel's Enterprise; A. K. Ramanujam’s Small-Scale Reflections on a Great House.

Unit 2 Prose
Khushwant Singh's The Portrait of a Lady; Jhumpa Lahiri's Short Story - Interpreter of Maladies.

Unit 3 Drama and Speech
Vijay Tendulkar's Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru / S. Radhakrishnan / A. P. J. Abdul Kalam’s My Vision for India etc. (any speech).

REFERENCES:

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15ENG232 INSIGHTS INTO LIFE THROUGH ENGLISH LITERATURE

OBJECTIVES: To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.

Unit 1 Poems

Unit 2 Short Stories

Unit 3 Prose

Practicals:
Role plays: The Proposal, Chekov / Remember Cezar, Gordon Daviot / Final Solutions, Mahesh Dattani, Book reviews, Movie reviews.

SUGGESTED READING: The Old Man and the Sea, Hemingway / Any one of the novels of R. K. Narayan, etc.

15ENG233 TECHNICAL COMMUNICATION

OBJECTIVES: To introduce the students to the elements of technical style; to introduce the basic elements of formal correspondence; to introduce technical paper writing skills and methods of documentation; to improve oral presentation skills in formal contexts.

Unit 1

Unit 2
Different kinds of written documents: Definitions – descriptions – instructions –
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**15ENG234 INDIAN SHORT STORIES IN ENGLISH 1 0 2 2**

**OBJECTIVES:** To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to help them study fiction relating it to the socio-cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianess.

**Unit 1**

**Unit 2**

**Unit 3**
Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

**TEXT:**

**REFERENCE:**

**15ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3**

**Unit 1**
State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People’s action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil/land degradation/pollution

**Unit 2**
Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people’s movements and activism, Indigenous knowledge systems and traditions of conservation.

**Unit 3**
Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes /Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

TEXTBOOKS / REFERENCES:

15FRE230 PROFICIENCY IN FRENCH LANGUAGE (LOWER) 1 0 2 2

Unit 1 Population - Identity
How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions;

Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2 The suburbs - At the train station
Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office…)

Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3 Paris and the districts - Looking for a room
Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.

Grammar – Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:
Metro St Michel - Publisher: CLE international

15GER230 GERMAN FOR BEGINNERS I 1 0 2 2

Unit 1
Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation.

Numbers 1-100; Saying the telephone number.

Countries and Languages.
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Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.

Vocabulary: Professions.

Unit 2
Giving the personal details. Name, age, marital status, year of birth, place of birth, etc.

Numbers till 1000. Saying a year.

Alphabets – spelling a word.
Filling up an application form; In the restaurant – making an order.
Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article

Vocabulary: Food items

Unit 3
Numbers above 1000. Orientation in Shopping plazas; asking the price, where do I find what, saying the opinion.

Grammar: Accusative – definite article. Adjectives and plural forms.

Vocabulary: Furniture and currencies.

15GER231  GERMAN FOR BEGINNERS II  1 0 2 2

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form.

Vocabulary: Consumables and measurements;

Unit 2
Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing up an appointment.

Grammar: Model verbs; Prepositions with time and place; Ordinal numbers.

Vocabulary: Leisure activities, weekdays, months and seasons.

15GER232  PROFICIENCY IN GERMAN LANGUAGE (LOWER)  1 0 2 2

To have an elementary exposure to German language; specifically
1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.
(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.)

Some useful websites will be given.

15GER233  PROFICIENCY IN GERMAN LANGUAGE (HIGHER)  1 0 2 2

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative.

Some German culture. Films.

15HIN101  HINDI I  1 0 2 2

OBJECTIVES: To teach Hindi for effective communication in different spheres of life - Social context, Education, governance, Media, Business, Profession and Mass communication.

Unit 1
Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindi language, Devanagari script and Hindi alphabet.
Shabda Bhed, Roopanthar ki Drishti se - Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed - Sangya ke Roopanthar - kriya.

Unit 2
Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender & number - General vocabulary for conversations in given context –understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit 3
Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4

Unit 5
Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Juloos.

BOOKS:
1. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran, Anuvad thaha Rachana: Dr. H. Parameswaran, Radhakrishna publishing House, New Delhi

15HIN111 HINDI II 1 0 2 2

OBJECTIVES: Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as anthology.

Unit 1
Kavya Tarang; Dhunil ke Anthim Kavitha [Poet-Dhumil]; Dhabba [Poet-Kedarnath Singh]; Proxy [Poet-Venugopal]; Vakth [Poet-Arun Kamal]; Maachis [Poet-Suneeta Jain].

Unit 2
Communicative Hindi - Moukhik Abhivyakthi

Unit 3
Audio-Visual – Media in Hindi – Movies like Tare Zameen par, Paa, Black etc.,

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appreciation and evaluation. News reading and presentations in Radio and TV channels in Hindi.

Unit 4
Gadya Manjusha – Budhapa,Kheesa, Sadachar ka Thavis

Unit 5

BOOKS:
2. Gadya Manjusha: Editor: Govind, Jawahar Pusthakalay, Mathura

15HUM230 EMOTIONAL INTELLIGENCE 2 0 0 2

Unit 1
Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Unit 3
Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost –savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies,Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:
15HUM231 GLIMPSES INTO THE INDIAN MIND: THE GROWTH OF MODERN INDIA

Unit 1
Introduction
General Introduction; ‘His + Story’ or ‘History’?; The concepts of ‘nation’, ‘national identity’ and ‘nationalism’; Texts and Textualities: Comparative Perspectives.

Unit 2
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3
Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:
Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao; V.S. Naipaul.

Conclusion.

REFERENCES:
1. Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.
2. Tagore, Rabindranath. The History of Bharatarvasha / On Nationalism / Greater India.
8. Nehru, Jawaharlal. The Quest from Discovery of India.

15HUM232 GLIMPSES OF ETERNAL INDIA

Unit 1
Introduction
A peep into India’s glorious past
Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira’s ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmans Dharma and the rise of Jainism and Buddhism – the sixteen Mahajanapadas and the beginning of Magadhan paramountcy – Kauhtiya and his Arhasatra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harasvardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region: The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2
India’s contribution to the world: spirituality, philosophy and sciences
Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization
What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wrecked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3
Women in Indian society
The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadaranyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kauhtiya’s Arhasatra and Mriechchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India
The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore; Understanding Mahatma Gandhi; A new nation
is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today: Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The ‘politics’ and ‘purpose’ of studying India.

REFERENCES:

17. Aurobindo, Sri. The Indian Renaissance / India's Rebirth / On Nationalism.
25. Danino, Michel. The Invasion That Never Was.
33. Dharmapal. Collected Works.
34. Dharmapal. Archival Compilations (unpublished)

15HUM233 GLIMPSES OF INDIAN ECONOMY AND POLITY 2 0 0 2

Unit 1

Introduction

General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.

Ancient India – up to 600 B.C.

Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarthas; The structure of ancient Indian polity – Rajamandala and Cakravartins – Pratigandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhishthira’s ramarajya; Sarasvati - Sindhu civilization and India’s trade links with other ancient civilizations; Towards chieftains and kingdoms – transformation of the polity; kingship – from gopati to bhupati; The mahajapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600 B.C. – 1200 A.D.

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya’s Arthasastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India’s maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas

Medieval India: 1200 A.D. – 1720 A.D.

Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.
Unit 3
Modern India: 1720 - 1947

the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was ‘traditional’ or ‘Indian’) – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry; the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways – money and credit – foreign trade; Towards partition – birth of two new nations – division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947
India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new / emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:
1. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.
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15HUM235  INDIAN CLASSICS FOR THE TWENTY-FIRST CENTURY

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2
The relevance of these classics in a modern age.

Unit 3
Goals of human life - existential problems and their solutions in the light of these classics etc.

REFERENCE:
The Bhagavad Gita, Commentary by Swami Chinmayananda

15HUM236  INTRODUCTION TO INDIA STUDIES

PREAMBLE: This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Unit 1
A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2
Modern India: Challenges and Possibilities.

Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3
Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:
Material given by the Faculty

BACKGROUND LITERATURE:
1. Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.
2. Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.
3. Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.
4. Outlines of Indian Philosophy, M. Hriyanna, MLBD.
5. An Advanced History of India, R. C. Majumdar et al, Macmillan.
6. India Since 1526, V. D. Mahajan, S. Chand & Company
7. The Indian Renaissance, Sri Aurobindo.
8. India's Rebirth, Sri Aurobindo.
13. Awaken Children: Conversations with Mata Amritanandamayi
15. Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.
16. Web of Indian Thought, Sister Nivedita
17. Essays on Indian Nationalism, Anand Kumaraswamy
18. Comparative Aesthetics, Volume 2, Kantil Chandra Pandey, Chowkhamba, Varanasi
19. The Invasion That Never Was, Michel Danino
20. Samskara, U. R. Ananthamurthy, OUP.
21. Hayavadana, Girish Karnard, OUP.
22. Naga-Mandala, Girish Karnard, OUP.

15HUM237  INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE

OBJECTIVES: To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit; to help students appreciate and imbibe India's ancient culture and values.

Unit 1
Unit 2
Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3

Unit 4

Unit 5
Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:
1. Vakya Vyavahara - Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi
2. The Wonder that is Sanskrit - Dr. Sampadananda Mishra, New Delhi

15HUM238 NATIONAL SERVICE SCHEME 2002

Unit 1
Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

Unit 2
Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

Unit 3
Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style.

15HUM239 PSYCHOLOGY FOR EFFECTIVE LIVING 2002

Unit 1 Self-Awareness & Self-Motivation
Self analysis through SWOT, Johari Window, Maslow's hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2 The Nature and Coping of Stress

Unit 3 Application of Health Psychology
Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

15HUM240 PSYCHOLOGY FOR ENGINEERS 2002

Unit 1
Psychology of Adolescents: Adolescence and its characteristics.

Unit 2
Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills, Mnemonics.
**Unit 3**

Attention & Perception: Definition, types of attention, perception.

**TEXTBOOKS:**

**REFERENCE BOOKS:**

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**15HUM241 SCIENCE AND SOCIETY – AN INDIAN PERSPECTIVE**

**Unit 1**

Introduction
Western and Indian views of science and technology
Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

**Unit 2**

Indian sciences
Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasutvan in circa 1500 AD

Science and technology under the British rule
Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

**Unit 3**

Science and technology in Independent India
Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition
Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion

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**REFERENCES:**
18. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.

* The syllabus and the study material in use herein has been developed out of a 'summer programme' offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M. D. Srinivas (Chairman) and Dr J. K. Bajaj (Director) of the CPS.
Unit 2
Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3


Unit 4

15HUM244  THE MESSAGE OF THE UPAISHADS  2 0 0 2

OBJECTIVES: To give students an introduction to the basic ideas contained in the Upanishads; and explores how their message can be applied in daily life for achieving excellence.

Unit 1
An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2
The challenge of human experience & problems discussed in the Upanishads – the True nature of Man – the Moving power of the Spirit – The Message of Fearlessness – Universal Man - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different manifestations of consciousness.

Unit 3
Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada,Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, ChakrayanaUshasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada’s answers to the six questions in Prasnopanishad.

REFERENCES:
1. The Message of the Upanishads by Swami Ranganathananda, BharatiyaVidya Bhavan
2. Eight Upanishads with the commentary of Sankaracharya, AdvaitaAshrama
3. Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press
4. Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore
5. Upanishads in Daily Life, Sri Ramakrishna Math, Mysalore.
7. Upanishad Ganga series – Chinmaya Creations

15HUM244 UNDERSTANDING SCIENCE OF 2 0 2 2 FOOD AND NUTRITION

Unit 1 Food and Food Groups
Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.

Cookery Practicals - Balanced Diet

Unit 2 Nutrients and Nutrition
Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

Practicals - Traditional Foods

Unit 3 Introduction to Food Biotechnology
Future foods - Organic foods and genetically modified foods, Fortification of foodsvalue addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals - Value added foods

TEXTBOOKS:

REFERENCE BOOKS:
15JAP230 PROFICIENCY IN JAPANESE LANGUAGE (LOWER)  1 0 2 2

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

15JAP231 PROFICIENCY IN JAPANESE LANGUAGE (HIGHER)  1 0 2 2

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak. Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they the students will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

15KAN101 KANNADA I  1 0 2 2

OBJECTIVES: To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Unit 1
Adalitha Kannada: bhashe, swaroopa, belavanigeya kiru parichaya
Paaribhaashika padagalu
Vocabulary Building

Unit 2
Prabhandha – Vyaaghra Geethe - A.N.Murthy Rao
Prabhandha – Baredidi...baredidi, Baduku mugiyuvudilla allige... - Nemi Chandra

15KAN111 KANNADA II  1 0 2 2

OBJECTIVES: To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Unit 1
Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2
Nanna Hanate - Dr.G.S.Shivarudrappa
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Ella Marethiruvaga - K. S. Nissaar Ahmed
Saviraru Nadigalu – S Siddalingayya

Unit 3

Unit 4
Sarva Sollegala turtu Maha Samelana - Beechi
Swarthakkaagi Tyaga - Beechi

Unit 5
Essay writing: Argumentative & Analytical
Précis writing

REFERENCES:
1. H. S. Krishnaswami Iyangar – Adalitha Kannada – Chetan Publication, Mysuru
2. Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhu Puatakha Bhavana
4. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house
5. Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication

15MAL101 MALAYALAM I

OBJECTIVES: To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Unit 1
Ancient poet trio: Adhyatmaramayanam, Lakshmana Swanthanam (valsa soumi/re... mungikidakayal), Ezhuthachan - Medieval period classics – Jnanappana (kalaminnu… vilasangalingane), Poonthanam

Unit 2

Unit 3
Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer - Literary & Cultural figures of Kerala and about their literary contributions.

REFERENCES:

15MAL111 MALAYALAM II

OBJECTIVES: To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Unit 1
Ancient poet trio: Kalayanasougandhikam, (kallum marangalun... namukkennarika vrikodara) Kunjan Nambiar - Critical analysis of his poetry - Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Translated by Attor Krishna Pisharody).

Unit 2

Unit 3
Anthology of short stories from period 3/4/5: Ninte Ormmayku, M.T.Vasudevan Nair - literary contributions of his time
Unit 4
Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5
Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam

Writing - a. Expansion of ideas; b. Précis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

15MAT111     CALCULUS AND MATRIX ALGEBRA     2 1 0 3

Unit 1 Calculus

Limit and Continuity: Limit (One-Sided and Two-Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity.


Unit 3 Matrix Algebra
Review: System of linear Equations, linear independence

Eigen values and Eigen vectors: Definitions and Properties, Positive definite, Negative Definite and Indefinite Matrices, Diagonalization and Orthogonal Diagonalization, Quadratic form, Transformation of Quadratic Form to Principal axes, Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian
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TEXTBOOK:

REFERENCE BOOKS:

15MAT204 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

Unit 1

Unit 2
Convolution, Integral Equations, Partial Fractions, Differential Equations, Systems of Differential Equations. (Sections: 6.1 to 6.7)


Unit 3

Partial Differential Equations: Basic Concepts, Modeling; Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series, Heat Equation; Solution by Fourier Series. (Sections: 12.1-12.5)

TEXTBOOK:

REFERENCE BOOKS:

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15MAT214 PROBABILITY AND STATISTICS

Unit 1
Random Variable and Distributions: Introduction to random variable – discrete and continuous distribution functions - mathematical expectations – moment generating functions and characteristic functions. Binomial, Poisson, Geometric, Uniform, Exponential. Normal distribution functions (MGF, mean, variance and simple problems) – Chebyshev’s theorem

Unit 2
Sampling Distributions: Distributions of Sampling Statistics, Chi-square, t and F distributions (only definitions and use). Central Limit Theorem.


Unit 3
Testing of Hypothesis: Large and small sample tests for mean and variance – Tests based on Chi-square distribution.

TEXTBOOK:

REFERENCE BOOKS:

15MAT302 NUMERICAL METHODS

Unit 1
Review of Errors: Accuracy and Precision, round-off error and truncation error. (Sec. 2.2-2.4)
Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, System of nonlinear equations. (Sec. 4.2, 4.3, 5.1-5.3, 5.5)

TEXTBOOK:

REFERENCE BOOKS:


Unit 2
Interpolation and Approximation: Lagrange and Newton interpolation for unequal intervals, Finite difference operators, Interpolating polynomials using finite differences. (Sec. 13.1 – 13.4, 13.6)

Unit 3
Review of Ordinary Differential Equations:


Lab-Implementation of these methods: MATLAB or EXCEL or Free and Open Source Software (FOSS) tools like R-programming and Scilab.

TEXTBOOK:

REFERENCE BOOKS:

15MEC100 ENGINEERING DRAWING - CAD 2023


TEXTBOOK:

REFERENCES:

15MEC180 WORKSHOP A 0021

1. Product Detailing Workshop
Disassemble the product of sub assembly - Measure various dimensions using measuring instruments - Free hand rough sketch of the assembly and components - Name of the components and indicate the various materials used - Study the functioning of the assembly and parts - Study the assembly and components design for compactness, processing, ease of assembly and disassembly - Assemble the product or subassembly.

2. Pneumatics and PLC Workshop
Study of pneumatic elements - Design and assembly of simple circuits using basic pneumatic elements - Design and Assembly of simple circuits using Electro-pneumatics.

Study of PLC and its applications - Simple programming using ladder diagrams.

3. Sheet Metal Workshop
Study of tools and equipments - Draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray etc.) Fabrication of components using small shearing and bending machines - Riveting and painting practice.

4. (a) Welding Workshop
Study of tools and equipments - Study of various welding methods - Arc welding practice and demonstration of gas welding and cutting.

(b) Demo and practice Workshop
Fitting: Study of tools, practice in chipping, filing and making joints.

Carpentry: Study of tools, planning practice and making joints

REFERENCE:
Concerned Workshop Manual
15PHY100  PHYSICS  3 0 0 3

Unit 1  Review of Classical Physics and dual nature of Waves / particle


Unit 2  Atomic Structure and Quantum Mechanics

Quantum Mechanics: Introduction - wave equation - Schrodinger's equation (time dependent and independent) - expectation values, operators, Eigen value (momentum and energy) – 1D potential box (finite and infinite) - tunnel effect - harmonic oscillator.

Unit 3  Statistical Mechanics and Solid State Physics


TEXTBOOK:

REFERENCE BOOK:
"Principles of Physics" by Halliday, Resnick and Walker, 9th edition

15PHY181  PHYSICS LAB.  0 0 2 1

Young's Modulus – Non Uniform Bending
Newton's Rings
Laser - Determination of Wavelength and Particle Size Determination
Spectrometer
Carey Foster's Bridge

15PHY230  ADVANCED CLASSICAL DYNAMICS  3 0 0 3

Unit 1  Introduction to Lagrangian dynamics
Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2  Central field problem
Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics
Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3  Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.

Practical rigid body problems
Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneuvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

TEXTBOOKS:
SYLLABI
B. Tech - Chemical Engg. 2015 admissions onwards

REFERENCE BOOKS:

15PHY233  BIOPHYSICS AND BIOMATERIALS  3 0 0 3

OBJECTIVE: To equip the students with the knowledge on different kinds of biomaterials and other medical need, basic research, and to provide an overview of theory and practice of bio materials.

Unit 1

Definition and classification of bio-materials, mechanical properties, visco-elasticity, wound-healing process, Application of biomaterial for the human body, body response to implants, blood compatibility. Implementation problems - inflammation, rejection, corrosion, structural failure. Surface modifications for improved compatibility.

Unit 2
Bioceramics, Biopolymers, Metals, ceramics and composites in medicine: Properties, applications, suitability & modifications required for certain applications.


Unit 3

TEXTBOOKS AND REFERENCES:
heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and its consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2
Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and its applications.

Unit 3
Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of the p-n junction rectifier, the n-p-n transistor.

TEXTBOOK:

REFERENCES:

15PHY239 ELECTROMAGNETIC FIELDS AND WAVES 3 0 0 3

Unit 1
Electrostatics: Coulombs law and electric field intensity, field due to a continuous volume charge distribution, field of a line charge, field of sheet of charge, electric flux density, Gauss’s law, application of Gauss’s law, Maxwell’s first equation.

Poisson’s and Laplace’s equations: The potential field of a point charge, potential field of a system of charges: conservative property, potential gradient, the dipole.

Unit 2
Poisson’s and Laplace’s equations, uniqueness theorem, examples of the solution of Laplace’s equation, solution of Poisson’s equation.

SYLLABI B. Tech - Chemical Enng. 2015 admissions onwards

Electromagnetics: Biot Savart law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, derivation of steady magnetic field laws, Faraday’s laws, displacement current, Maxwells equations in point and integral form, retarded potentials

Unit 3
Electromagnetic waves: EM wave motion in free space, wave motion in perfect dielectrics, plane wave in lossy dielectrics, Poynting vector and power consideration, skin effect, reflection of uniform plane waves, standing wave ratio.

Transmission line equations, line parameters-examples, dipole radiation, retarded potentials, electric dipole radiation.

TEXTBOOK:

REFERENCES:

15PHY240 ELECTRONIC MATERIALS SCIENCE 3 0 0 3

Unit 1
Types of bonding in solids, Crystallography and crystalline defects: Crystallography, Directions and planes, Crystalline defects, line defects, Planar defects, Volume defects; Binary and Ternary Phase Diagrams: Lever rule and phase rule, Eutectic, peritectic and Eutectoid systems, Applications of Phase diagrams; Basic Quantum Physics - atomic structure, Use of band theory and occupation statistics to explain existence and basic properties of metals and nonmetals. Working of Semiconductor Devices using band diagrams and their electrical characteristics: pn junctions, BJT, MOSFET.

Unit 2
Use of band theory to explain optoelectronic properties of materials and optoelectronic devices: LEDs, Solar Cells, Lasers, pin diodes, photodiodes; Magnetic properties and Superconductivity: Magnetic moments and Magnetic Permeability, types of magnetism, saturation magnetization, magnetic domains, soft and hard magnetic materials, superconductivity and its origin, Giant Magneto Resistance, Josephson effect, Energy band diagrams and Magnetism, Applications of magnetic materials- Magnetic recording materials, etc.
Unit 3

TEXTBOOK:

REFERENCE:

15PHY241 LASERS IN MATERIAL PROCESSING 3 0 0 3

Unit 1
Basic optical theory: Nature of electromagnetic radiation, interaction of radiation with matter, reflection, refraction, polarization, laser fundamentals, laser beam characteristics, beam quality (laser cavity modes), Q-switching, mode locking, continuous wave, types of lasers, energy and power.

Laser interaction with materials: Optical properties of materials, laser interaction with metals, insulators, semiconductors, polymers and biological materials.


Unit 2
Laser cutting and drilling: Mechanism for inert gas and oxygen-assisted cutting, factors controlling cut quality and kerf width. Laser assisted drilling.

Laser welding: Introduction to laser keyhole welding and contrast with conduction limited welding, applications.

Direct laser fabrication (DLF): Laser sintering & laser rapid manufacturing, comparison with rapid prototyping. Main potential and limitations of DLF for direct fabrication and for the production of novel engineering materials and structures.

Unit 3
Laser forming: Mechanisms involved, including thermal temperature gradient, buckling, upsetting. Applications in alignment and straightening and in rapid production processes.

Scope of application of laser materials processing: focused on industrial application of laser in materials processing including laser welded tailored blanks.

Laser safety: Introduction to safety procedures in the use of lasers, including wavelength effects and laser safety standards.

REFERENCES:

15PHY243 MICROELECTRONIC FABRICATION 3 0 0 3

Unit 1
Introduction to semiconductor fabrication – scaling trends of semiconductor devices; crystal structure of semiconductor materials, crystal defects, phase diagrams and solid solubility; physics of Czochralski growth of single crystal silicon, Bridgeman method for GaAs, float zone process; diffusion science: Ficks laws of diffusion, atomistic models of diffusion, dopant diffusion mechanisms; kinetics of thermal oxidation, Deal-Grove Model, nitridation of silicon, structure and characteristics of oxides, effect of dopants on oxidation kinetics, dopant redistribution;

Unit 2
Physics of ion implantation: Coulombic scattering and projected range, nuclear and electronic stopping, channeling, implantation damage removal, dopant activation by rapid thermal annealing; principles of optical lithography – optics and diffraction, light sources and spatial coherence, physics of pattern transfer, nodulation transfer function; chemistry of lithographic processes: organic and polymeric photoresists, developing and exposure, contrast; principles of non-optical lithography: electron beam, X-ray lithography, resists, sources; etching: Chemistry of wet etching, plasma physics, chemistry of plasma etching and reactive ion etching; chemical mechanical polishing,
Unit 3
Vacuum science: Kinetic theory of gases, gas flow and conductance, vacuum pumps and seals; deposition of thin films: physics of sputtering and evaporation, step coverage and morphology of deposited films, chemical vapor deposition: chemical equilibrium and law of mass action, gas flow and boundary layers, types of CVD, plasma assisted CVD; thermodynamics of epitaxial growth, types molecular beam epitaxy, isolation and contact formation – LOCOS and trench, silicides, metallization with Al and Cu; process Integration: CMOS, bipolar process flow.

TEXTBOOK:
Stephen Campbell, Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2001

REFERENCE:

15PHY245 NUCLEAR ENERGY: PRINCIPLES AND APPLICATIONS 3 0 0 3

Unit 1

Fission and fusion: The fission process, energetic of fission, byproducts of fission, energy from nuclear fuels. Fusion reactions, electrostatic and nuclear forces, thermo nuclear reactions in plasma. Energetics of fusion. Comparison of fusion and fission reactions.

Unit 2
Neutron chain reactions and nuclear power: Criticality and multiplication, factors governing the multiplication, neutron flux and reactor power, reactor types and reactor operations. Methods of heat transmission and removal, steam generation and electric power generation, waste heat disposal.

Unit 3
Breeder reactors and fusion reactors: The concept of breeding nuclear fuel, isotope production and consumption, fast breeder reactor, breeding and uranium sources. Technical problems in the functioning of fusion reactor, requirements for practical fusion reactors, magnetic confinement, inertial confinement and other fusion concepts. Prospects of fusion power.

TEXTBOOK:

REFERENCES:
1. David Bodansky, Nuclear Energy: principles, practices and prospects, Springer Verlag

15PHY247 PHOTOVOLTAICS 3 0 0 3

Unit 1
Introduction to semiconductors: Semiconductors: concept of electron and holes, conduction in semiconductors and concentration of charge carriers in semiconductors. Direct and indirect band gap semiconductors (quantum mechanical treatment). Extrinsic semiconductors: n-type, p-type & compensation doping, carrier concentration; PN junction - concept of bands at PN junction, junction under forward and reverse biases (conceptual).

Unit 2


Unit 3

Advanced Solar cell technologies (III Generation): Alternatives to conventional Si based solar cells - Thin film solar cells, Hetero junction solar cells, Tandem solar
cells: material properties, fabrication and stability (includes nano scale devices). Organic solar cells.

**TEXTBOOK:**

**REFERENCES:**

**15PHY248 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3**

**Unit 1**
Review of some basic concepts and principle of laser.


**Unit 2**
Properties of LASERS
Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of \( \Delta \omega \) FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

**Unit 3**
Types of LASERS

**REFERENCES:**

**15PHY250 QUANTUM PHYSICS AND APPLICATIONS 3 0 0 3**

**Unit 1**

**Unit 2**
Bosons and Fermions - symmetric and antisymmetric wavefunctions - elements of statistical physics: density of states, fermi energy, Bose condensation - solid state physics: Free electron model of metals, elementary discussion of band theory and applications to semiconductor devices.

Einstein coefficients and light amplification - stimulated emission - optical pumping and laser action.

**Unit 3**
Nuclear physics: nuclear properties - binding energy and mass formula - nuclear decay with applications - theory of alpha decay - nuclear forces – fission - principle of nuclear reactor - elementary particles - leptons, hadrons, quarks, field bosons - the standard model of elementary particles.

**TEXTBOOK:**

**REFERENCES:**

**SYLLABI**
15PHY251  **THIN FILM PHYSICS**  3 0 0 3

**Unit 1**

Defects in thin film: General concepts, nature of defect, microscopic defect and dislocation. Boundary defects. Defect and energy states - donor acceptor levels, trap and recombination centers, excitons, phonons.

**Unit 2**

Properties of thin film: Optical behaviors: transmission, reflection, refractive index, photoconductivity, and photoluminescence.

**Unit 3**
Electrical behaviors: sheet resistivity, electron mobility and concentration, Hall effect, conduction in MIS structure.

Mechanical behaviors: stress, adhesion, hardness, stiffness.

Applications of thin films in various fields: Antireflection coating, FET, TFT, resistor, thermistor, capacitor, solar cell, and MEMs fabrication of silicon wafer: Introduction. preparation of the silicon wafer media, silicon water processing steps.

**TEXTBOOK:**

**REFERENCES:**
2. A. Goswami, *“Thin Film Fundamentals”*, New Age International, Pvt Ltd. New Delhi, 1996.

**SYLLABI**
15PHY331  **ASTRONOMY**  3 0 0 3

**Unit 1**

**Unit 2**
Observational Astronomy
Observing the Universe - The classic Newtonian telescope - The Cassegrain telescope - Catadioptric telescopes - The Schmidt camera - The Schmidt – Cassegrain telescope - The Maksutov–Cassegrain telescope - Active and adaptive optics - Some significant optical telescopes - Gemini North and South telescopes - The Keck telescopes - The South Africa Large Telescope (SALT) - The Very Large Telescope (VLT) - The Hubble Space Telescope (HST) - The future of optical astronomy - Radio telescopes - The feed and low noise amplifier system - Radio receivers - Telescope designs - Large fixed dishes - Telescope arrays - Very Long Baseline Interferometry (VLBI) - The future of radio astronomy - Observing in other wavebands – Infrared – Sub-millimetre wavelengths - The Spitzer space telescope - Ultraviolet, X-ray and gamma-ray observatories - Observing the universe without using electromagnetic radiation - Cosmic rays - Gravitational waves.

**Unit 3**
The Properties of Stars: Stellar luminosity - Stellar distances - The hydrogen spectrum - Spectral types - Spectroscopic parallax - The Hertzsprung – Russell Diagram - The...
main sequence - The giant region - The white dwarf region - The stellar mass – luminosity relationship - Stellar lifetimes - Stellar Evolution – White dwarfs - The evolution of a sun-like star - Evolution in close binary systems – Neutron stars and black holes - The discovery of pulsars - Black holes: The Milky Way - Open star clusters - Globular clusters - Size, shape and structure of the Milky Way – observations of the hydrogen line - Other galaxies - Elliptical galaxies - Spiral galaxies - The Hubble classification of galaxies - The universe - The Cepheid variable distance scale - Starburst galaxies - Active galaxies - Groups and clusters of galaxies – Supercubers - The structure of the universe - Cosmology – the Origin and Evolution of the Universe - The expansion of the universe - The cosmic microwave background - The hidden universe: dark matter and dark energy - The Drake equation - The Search for Extra Terrestrial Intelligence (SETI) - The future of the universe.

**TEXTBOOK:**
*Introduction to Astronomy and Cosmology, Ian Morison, Wiley (UK), 2008*

**REFERENCE BOOK:**

**CONCEPTS OF NANOPHYSICS AND NANOTECHNOLOGY**

**Unit 1**
Introduction
Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement

**Unit 2**
Tools for characterization:

**Nanoscale materials – properties and applications:**
Carbon nanostructures – structure, electrical, vibration and mechanical properties.
Applications of carbon nanotubes

**Unit 3**

Nanoelectronics and nanodevices:
Impact of nanotechnology on conventional electronics. Nano electromechanical systems (NEMSs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

**TEXTBOOKS:**
Unit 3
Nuclear magnetic resonance imaging (MRI) – principle - chemical shift - magnetic resonance signal induction and relaxation - pulse sequencing and spatial encoding.


TEXTBOOK:

REFERENCE BOOKS
1. Glasser O, Medical Physics Vol. 1, 2, 3 Book Publisher Inc Chicago, 1980

15PHY338        PHYSICS OF SEMICONDUCTOR DEVICES   3 0 0 3

Unit 1
Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects.


Unit 2

Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown.

Unit 3


Modern semiconducting devices: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

TEXTBOOKS:

REFERENCES:

15PHY532        ASTROPHYSICS   3 0 0 3

Unit 1

Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics - Kepler’s laws - and derivations from Newton’s laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.
Unit 3
Galactic astronomy: Distance measurement - red shifts and Hubble's law – age of the universe, galaxies – morphology - Hubble’s classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.


Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - plank length and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:
5. ‘Stellar Astronomy’ by K. D Abhayankar.

15PHY535      EARTH’S ATMOSPHERE     3 0 0 3

Unit 1
Earth's atmosphere: overview and vertical structure. Warming the earth and the atmosphere: temperature and heat transfer; absorption, emission, and equilibrium; incoming solar energy, Air temperature: daily variations, controls, data, human comfort, measurement. Humidity, condensation, and clouds: circulation of water in the atmosphere; evaporation, condensation, and saturation; dew and frost; fog.

Unit 2

TEXTBOOK:

REFERENCE:

15PHY536      EARTH’S STRUCTURE AND EVOLUTION     3 0 0 3

Unit 1
Introduction: geologic time; earth as a system, the rock cycle, early evolution, internal structure & face of earth, dynamic earth. Matter and minerals: atoms, isotopes and radioactive decay; physical properties & groups of minerals; silicates, important nonsilicate minerals, resources. Igneous rocks: magma, igneous processes, compositions & textures; naming igneous rocks; origin and evolution of magma, intrusive igneous activity, mineral resources and igneous processes.

Unit 2
Volcanoes and volcanic hazards: materials extruded, structures and eruptive styles, composite cones and other volcanic landforms, plate tectonics and volcanic activity. Weathering and soils: earth's external processes; mechanical & chemical weathering, rates; soils, controls of formation, profile, classification, human impact,
erosion, weathering and ore deposits. Sedimentary rocks: the importance and origins of sedimentary rocks; detrital & chemical sedimentary rocks, coal, converting sediment into sedimentary rock; classification & structures, nonmetallic mineral & energy resources. Metamorphism and metamorphic rocks: metamorphic textures, common metamorphic rocks, metamorphic environments & zones.

Unit 3

Unit 4
Shorelines: coastal zone, waves & erosion, sand movement, shoreline features & stabilization; erosion problems along U.S. coasts, hurricanes, coastal classification, tides. Earthquakes and earth’s interior: faults, seismology, locating the source of an earthquake, measuring intensity, belts and plate boundaries, destruction, damage east of the Rocky Mountains, earthquake prediction, earth’s interior. Plane tectonics: continental drift, divergent boundaries, convergent boundaries, transform fault boundaries, testing the plate tectonics model, the breakup of Pangaea, measuring plate motion, what drives plate motions, plate tectonics in the future.

Unit 5
Origin and evolution of the ocean floor: continental margins, features of deep-ocean basins, anatomy of oceanic ridge, oceanic ridges and seafloor spreading, nature of oceanic crust, continental rifting, destruction of oceanic lithosphere. Crustal deformation and mountain building: structures formed by ductile & brittle deformation, mountain building at subduction zones, collisional mountain belts, fault-block mountains, vertical movements of the crust. Geologic time: time scales, relative dating, correlation of rock layers; dating with radioactivity, the geologic time scale, difficulties in dating. Earth’s evolution: birth of a planet, origin of the atmosphere and oceans, Precambrian (formation of continents); Phanerozoic (formation of modern continents & earth’s first life); Paleozoic (life explodes); the Mesozoic (dinosaurs); Cenozoic era (mammals). Global climate change: climate & geology, climate system, detecting change; atmospheric basics & heating the atmosphere; natural & human causes; carbon dioxide, trace gases, and climate change; climate-feedback mechanisms, aerosols, some possible consequences.

TEXTBOOK:

REFERENCE:

15PHY540 NON-LINEAR DYNAMICS 3 0 0 3

Unit 1
Introduction: examples of dynamical systems, driven damped pendulum, ball on oscillating floor, dripping faucet, chaotic electrical circuits.

One-dimensional maps: the logistic map, bifurcations in the logistic map, fixed points and their stability, other one-dimensional maps.

Non-chaotic multidimensional flows: the logistic differential equation, driven damped harmonic oscillator, Van der Pol equation, numerical solution of differential equations.

Dynamical systems theory: two-dimensional equilibrium and their stability, saddle points, are contraction and expansion, non-chaotic three-dimensional attractors, stability of two-dimensional maps, chaotic dissipative flows.

Unit 2
Lyapunov exponents: for one- and two-dimensional maps and flows, for three-dimensional flows, numerical calculation of largest Lyapunov exponent, Lyapunov exponent spectrum and general characteristics, Kaplan-Yorke dimension, numerical precautions.

Strange attractors: general properties, examples, search methods, probability of chaos and statistical properties of chaos, visualization methods, basins of attraction, structural stability.

Bifurcations: in one-dimensional maps and flows, Hopf bifurcations, homoclinic and heteroclinic bifurcations, crises.

Hamiltonian chaos: Hamilton’s equations and properties of Hamiltonian systems, examples, three-dimensional conservative flows, symplectic maps.
Unit 3
Time-series properties: examples, conventional linear methods, a case study, time-delay embeddings.

Nonlinear prediction and noise-reduction: linear predictors, state-space prediction, noise reduction, Lyapunov exponents from experimental data, false nearest neighbours.

Fractals: Cantor sets, curves, trees, gaskets, sponges, landscapes.

Calculations of fractal dimension: similarity, capacity and correlation dimensions, entropy, BDS statistic, minimum mutual information, practical considerations.

Fractal measure and multifractals: convergence of the correlation dimension, multifractals, examples and numerical calculation of generalized dimensions.

Non-chaotic fractal sets: affine transformations, iterated functions systems, Mandelbrot and Julia sets.

Spatiotemporal chaos and complexity: examples, cellular automata, coupled map lattices, self-organized criticality.

TEXTBOOK:
REFERENCES:

15PHY542 OPTOELECTRONIC DEVICES 3 0 0 3

Unit 1

Basics of semiconductor optics: Dual nature of light, band structure of various semiconductors, light absorption and emission, photoluminescence, electroluminescence, radioactive and non-radiative recombination, wave trains.

Unit 2
Semiconductor light-emitting diodes: Structure and types of LEDs and their characteristics, guided waves and optical modes, optical gain, confinement factor, internal and external efficiency, semiconductor heterojunctions, double-heterostructure LEDs.

Semiconductor lasers: Spontaneous and stimulated emission, principles of a laser diode, threshold current, effect of temperature, design of an edge-emitting diode, emission spectrum of a laser diode, quantum wells, quantum-well laser diodes.

Unit 3
Semiconductor light modulators: Modulating light (direct modulation of laser diodes, electro-optic modulation, acousto-optic modulation), isolating light (magneto-optic isolators), inducing optical nonlinearity (frequency conversion, switching)

Semiconductor light detectors: I-V characteristics of a p-n diode under illumination, photovoltaic and photoconductive modes, load line, photocells and photodiodes, p-i-n photodiodes, responsivity, noise and sensitivity, photodiode materials, electric circuits with photodiodes, solar cells.

REFERENCES:
SYLLABI
B. Tech - Chemical Engg.
2015 admissions onwards

Unit 3
Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4
Selected slokas from Valmiki Ramayana, Kalidasa’s works and Bhagavad Gita.

Ramayana – chapter VIII - verse 5, Mahabharata - chapter 174, verse 16, Bhagavad Gita – chapter - IV verse 8, Kalidasa’s Sakuntalam Act IV – verse 4

Unit 5
Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:
1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press

15SAN111
SANSKRIT II

OBJECTIVES: To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Unit 1
Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2
Ktvatu Pratyaya, Upasargas, Ktvanta, Tumunnanta, Lyabanta.

Three Lakaras – brief introduction, Lot lakara.

Unit 3
Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4
Introduction to classical literature, classification of Kavyas, classification of Dramas

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- The five Mahakavyas, selected slokas from devotional kavyas - Bhagavad Gita – chapter - II verse 47, chapter - IV verse 7, chapter - VI verse 5, chapter - VIII verse 6, chapter - XVI verse 21, Kalidasa’s Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 - 120, Neetisara chapter - III

Unit 5
Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:
1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R. S. Vadhyar and Sons, Kalpathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kalpathi, Palakkad
6. Namalinganusasanam by Amarasimha published by Travancore Sanskrit series
7. Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar Press

15SSK221
SOFT SKILLS I

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world. Importance of positive attitude, self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Schools of Engineering Amrita Vishwa Vidyapeetham S135
Schools of Engineering Amrita Vishwa Vidyapeetham S136
Problem solving level I: Number system; LCM & HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS:
5. Quantitative Aptitude by R. S. Aggarwal, S. Chand
6. Quantitative Aptitude – Abijith Guha, TMH.
7. Quantitative Aptitude for Cat - Arun Sharma. TMH.

REFERENCES:
3. The BBC and British Council online resources
4. Owl Purdue University online teaching resources www.the grammarbook.com - online teaching resources
5. www.englishpage.com- online teaching resources and other useful websites.

15SSK331

SOFT SKILLS III 1 0 2 2

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group
development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation/knowledge about the company, professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Coordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking strategies.

**TEXTBOOKS:**

5. Data Interpretation by R. S. Aggarwal, S. Chand
6. Logical Reasoning and Data Interpretation – Niskit K Sinkha
7. Puzzles – Shakuntala Devi

**REFERENCES:**

SYLLABI
B. Tech - Chemical Engg. 2015 admissions onwards

Work place – definition, concept, prevalence of mental health issues in the work place, why invest in workplace mental health, relationship between mental health and productivity, organizational culture and mental health. Case Study, Activity.

Unit 2
Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues - Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders- Schizophrenia, Bipolar Disorder, Personality disorders, Crisis Situations-Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues -work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid - Meaning. Case Study, Activity.

Unit 3
Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being- corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals - talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations, Case Study, Activity.

REFERENCES:
3. Canadian Mental Health Association, Ontario “Workplace mental health promotion, A how to guide” wrmp.cmhaontario.ca/
6. Mental Health Act 1987 (India) www.inhealth.org/mha.htm
7. Persons with disabilities Act 1995 (India) www.socialjustice.nic.in
8. The Factories Act 1948 (India) www.caaa.in/Image/19ulabourlawshb.pdf
SYLLABI
B. Tech - Chemical Engg.
2015 admissions onwards

ISTAM11
TAMIL I I

Objectives: To learn the history of Tamil literature. To analyze different styles, language training, to strengthen the creativity in communication, Tamil basic grammar, Computer and its use in Tamil language.

Unit 1

Unit 2
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Unit 3
tamil ilakkaṟṟum: Vakkiya vakaikaḷ - tarviṟṟai pāṭṭiṟṟai - nēkkṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟṟrabbit

Unit 4