B. Tech. CHEMICAL ENGINEERING

SCHEME AND SYLLABI (with effect from 2021-22)

B.Tech. (Biotechnology)

I Year - I Semester

Course code	Category	Course Title	Hours per week L	P	Internal Marks	External Marks	Total Marks	Credits
BT-1101	BS	Maths – I	4	0	30	70	100	3
BT-1102	BS	Physics	4	0	30	70	100	3
BT-1103	ES	Engineering Graphics	2	3	30	70	100	3
BT-1104	ES	Biology	4	0	30	70	100	3
BT-1105	ES	Microbiology	4	0	30	70	100	3
BT-1106	ES	Workshop	0	3	50	50	100	1.5
BT-1107	BS	Physics Lab	0	3	50	50	100	1.5
BT-1108	ES	Microbiology Lab	0	3	50	50	100	1.5
		Total Credits						19.5

I Year - II Semester

BT-1201	BS	Maths – II	4	0	30	70	100	3
BT-1202	BS	Chemistry	4	0	30	70	100	3
BT-1203	HSS	English	4	0	30	70	100	3
BT-1204	ES	CPNM	4	0	30	70	100	3
BT-1205	ES	Genetics	4	0	30	70	100	3
BT-1206	HSS	English Language Lab	0	3	50	50	100	1.5
BT-1207	BS	Chemistry Lab	0	3	50	50	100	1.5
BT-1208	ES	CPNM Lab	0	3	50	50	100	1.5
		Total Credits						19.5

II Year - I Semester

BT-2101	BS	Biochemistry	4	0	30	70	100	3
BT-2102	PC	Immunology	4	0	30	70	100	3
BT-2103	PC	Bio-analyticalTechniques	4	0	30	70	100	3
BT-2104	PC	Downstream Processing	4	0	30	70	100	3
BT-2105	HSS	Managerial Economics	4	0	30	70	100	3
BT-2106	PC	Biochemistry LAB	0	3	50	50	100	1.5
BT-2107	PC	Bio-analyticalTechniques LAB	0	3	50	50	100	1.5
BT-2108	PC	Downstream Processing LAB	0	3	50	50	100	1.5
BT-2109	SC	MATLAB (Software)	1	2	50	50	100	2
BT-2110	MC	Professional Ethics & Universal Human values	0	0	-	100	100	0
BT-2111	MC	NCC/NSS	0	2	-	-	-	0
		Total Credits						21.5

II Year - II Semester

BT-2201	ES	Basic Electrical and Electronics Engineering	4	0	30	70	100	3
BT-2202	BS/PC	Material and Energy Balances	4	0	30	70	100	3
BT-2203	PC	Fluid Mechanics and Particle Technology	4	0	30	70	100	3
BT-2204	PC	Biochemical Thermodynamics	4	0	30	70	100	3
BT-2205	PC	Plant cell and tissue culture	4	0	30	70	100	3
BT-2206	PC	Fluid Mechanics and Particle Technology LAB	0	3	50	50	100	1.5
BT-2207	PC	Plant cell and tissue culture LAB	0	3	50	50	100	1.5
BT-2208	SC	ASPEN PLUS(Process design)	1	2	50	50	100	2
BT-2209	MC	Environmental Science	0	0	-	100	100	0
		Total Credits						20.0
		Internship-I						

III Year - I Semester

BT-3101	PC	Heat and Mass Transfer	4	0	30	70	100	3
BT-3102	PC	Enzyme Engineering	4	0	30	70	100	3
BT-3103	PC	Cell and MolecularBiology	4	0	30	70	100	3
BT-3104	PE	Professional Elective -I	4	0	30	70	100	3
BT-3105	OE	Open Elective-I	4	0	30	70	100	3
BT-3106	PC	Heat and Mass transfer Lab	0	3	50	50	100	1.5
BT-3107	PC	Cell and molecular biology Lab	0	3	50	50	100	1.5
BT-3108	SC	Bio Instrumentation	1	2	50	50	100	2
BT-3109	INT	Internship – I			50	50	100	2
		Total Credits						22.0

III Year - II Semester

BT-3201	PC	Genetic Engineering	4	0	30	70	100	3
BT-3202	PC	Bioinformatics	4	0	30	70	100	3
BT-3203	PC	Biochemical ReactionEngineering	4	0	30	70	100	3
BT-3204	PE	Professional Elective-II	4	0	30	70	100	3
BT-3205	OE/ JOE	Open Elective-II	4	0	30	70	100	3
BT-3206	PC	Process control Lab	0	3	50	50	100	1.5
BT-3207	PC	Biochemical reactionEngineering Lab	0	3	50	50	100	1.5
BT-3208	PC	Bioinformatics Lab	0	3	50	50	100	1.5
BT-3209	SC	Soft Skills	1	2	50	50	100	2
		Total Credits						21.5
		Internship – II						

IV Year - I Semester

BT-4101	PE	Professional Elective-III	4	0	30	70	100	3
BT-4102	PE	Professional Elective-IV	4	0	30	70	100	3
BT-4103	PE	Professional Elective-V	4	0	30	70	100	3
BT-4104	OE	Open Elective-III	4	0	30	70	100	3
BT-4105	OE	Open Elective-IV	4	0	30	70	100	3
BT-4106	HSSE	HSS Elective	4	0	30	70	100	3
BT-4107	SC	Biostatistics	1	2	50	50	100	2
BT-4108	INT	Internship – II			50	50	100	2
		Total Credits						22.0

IV Year - II Semester

BT-4201	PROJ	Project work			100	100	200	14
		Total Credits						14.0

PROFESSIONAL ELECTIVES

1. Process Control
2. Agricultural Biotechnology
3. Engineering Economics and Bio Process Design
4. Industrial Biotech Products
5. Pharmaceutical Biotechnology
6. Animal cell culture and Hybridoma Technology
7. Cancer Biology
8. Stem cells in health care
9. Food technology
10. Process optimization
11. Energy Engineering
12. Systems Biology
13. Environmental Biotechnology
14. Bio Process Engineering
15. Process Modeling and Simulation

OPEN ELECTIVES

1. Corrosion Engineering
2. White Ware & Heavy Clay Ware
3. Ceramic Raw Materials
4. Nano Science & Technology
5. Industrial Safety and Management
6. Fuels, Refractories and Furnaces
7. Biochemical Engineering
8. Industrial Pollution Control Engineering
9. CO2 Capture, Sequestration & Utilization
10. Design of Experiments
11. Renewable Energy Sources
12. Energy Technologies

HSS Elective

1. Industrial Management & Entrepreneurship
2. Organizational Behavior
3. Operations Research

BT-1101 MATHEMATICS-I

Course Objectives:

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes:

* Find the partial derivatives of functions of two or more variables.

* Evaluate maxima and minima, errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs).

Applications of Partial Differentiation: Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables

- Errors and approximations -Total differential. Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Multiple Integrals: Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Fourier Series:

Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

BT-1102 PHYSICS

Course Objectives:

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.

· To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.

· To Learn basics of lasers and optical fibers and their use in some applications.

· To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:

· Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.

· Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .

· Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit

· Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.

· Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

Thermodynamics: Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism: Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics : Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

OPTICS

Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

Polarisation: Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

Lasers And Fibre Optics: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

Modern Physics: Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

Nanophase Materials: Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications of nano materials.

Text Books :

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.

2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books:

1. Modern Engineering Physics by A.S. Vadudeva

2. University Physics by Young and Freedman

BT-1103 ENGINEERING GRAPHICS

Course Objectives:

* Understand the basics of Engineering Graphics and BIS conventions.

* Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings

* Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.

* Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids

* Demonstrate and practice the development of surfaces of simple solids

* Familiarize the basic concept of isometric views clearly.

Course Outcomes:

* Develop simple engineering drawings by considering BIS standards.

* Able to draw different engineering curves with standard Procedures

* Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.

* Visualize clearly the sections of solids.

* Apply the concepts of development of surfaces while designing/analyzing any product.

* Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

SYLLABUS

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.

Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

Text Book:

Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.

Reference Book:

Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill

BT-1104 BIOLOGY

Course Objectives:

* To study about the cell structure and function.

* To study about the plant structure, functions of various cells in the plants, flower

* structure, pollination and fertilization.

* To study about the physiological processes in the plant and various methods of plant

* breeding techniques.

* To study about the general characters of animals- invertebrates, vertebrates.

* To study about the general physiological processes like digestion, respiration, and

* excretion etc of the animals.

Course Outcomes:

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

* Obtain knowledge in the biological processes occurring in the cells.

* Make use of structure of plants, and understand the phenomena of Embryology so that

* they produce new varieties of plants.

* Analyze various physiological processes of the plants in plant breeding techniques.

* Understand the general characters of animals, the phenomena of reproduction and life

* cycle of plasmodium vival.

* Illustrate various physiological processes of the animals. Digestion, respiration

* Excretory system, Nervous system functions are understood to the student so that

* student can do research in their future studies.

SYLLABUS

Cell Biology: Structure and function of prokaryotic and eukaryotic cell, cell organelles, cell membrane, chloroplast, mitochondria, golgi complex, endoplasmic reticulum, lysosomes, ribosomes and nucleus, chromosome structure, mitosis and meiosis,

Plant Biology: Parts of a flowering plant; flower-structure of a typical flower, outline description of floral parts – androecium, gynoecium,

Embryology: Structure of anther, microsporogenesis and development of male gametophyte, structure of ovule, megasporogenesis, development of embryo sac. fertilization, process of fertilization and post fertilization changes,

Anatomy: Structure and function of xylem and phloem, internal structure of dicot root, stem and leaf, monocot root, stem and leaf, secondary growth of dicot stem,

Plant Physiology: Water relations of plants, absorption of water by plants, diffusion, water potential, osmosis, plasmolysis, imbibition, active and passive absorption,

Mineral nutrition: Criteria for essentiality, macro elements (nitrogen, phosphorus and potassium) and microelements,

Photosynthesis: photosynthetic pigments, light reaction-Emerson enhancement effect, photo system I and II, photolysis of water, photophosphorylation, CO_2 fixation – C3, C4 and CAM pathway, photorespiration, factors affecting photosynthesis – Blackman's law of limiting factors,

Nitrogen metabolism: Introduction, nitrogen cycle, biological nitrogen fixation,

Plant Growth Regulators: Auxins, gibberellins, cytokinins, abscisic acid and ethylene,

Plant Breeding: Methods of plant breeding: selection, hybridization, hybrid vigor and mutational breeding,

Animal Biology: General characters of invertebrates, morphology, life cycle and reproduction of Plasmodium Vivax, general characters of vertebrates.

Animal Physiology: Animal nutrition- modes of nutrition, digestive system of humans and accessory digestive organs, gastrointestinal secretions,

digestion, absorption and assimilation of digested products, egestion,

Respiration: Respiration in humans – respiratory system, mechanism of respiration,

Circulatory system: Blood vascular system in humans, blood and its components, heart, pumping action of heart, heart beat and pulse, important blood vessels and course of blood circulation, lymphatic system-lymph, lymph vessels, lymph nodes and lymphatic ducts and pacemakers,

Excretion: Elimination of nitrogenous waste- ammonotelic, ureotelic and uricotelic, structure of human excretory system, structure of urinary system, anatomy of kidney, and structure of nephron,

Nervous system: Structure of neuron, nerve impulse and its conduction, synapse, central nervous system- lobes of brain and its meninges, spinal cord, Peripheral nervous system- Cranial nerves and spinal nerves, autonomous nervous system, sympathetic and parasympathetic nervous system, reflex action, reflex arch of humans.

Text Books:

1. 'Biology Text Book for class XI and XII', NCERT.

2. 'AP Academy Text Book for Botany and Zoology, for intermediate

BT-1105 MICROBIOLOGY

Course objectives:

* To make the student learn about origin and evolution of microbes.

* To make the student understand structure and functioning of different microbial

* groups.

* To make them to acquaint the cultivation of microbes in artificial medium.

Course Outcomes:

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

* Demonstrate the origin and evolution of microbes

* Understand structure and functioning of different microbial groups.

* Understand the importance of microbes in ecosystem

* Explain why microorganisms are ubiquitous in nature, inhabiting a multitude of

* habitats and occupying a wide range of ecological habitats.

SYLLABUS

History and Development of Microbiology: Contributions of van Leeuwenhock, Joseph Lister, Pasteur, Koch, Jenner, Winogradsky, Beijerinck, further developments of microbiology,

Microbial Taxonomy: Bacteria, archea and their broad classification. Molecular approaches to microbial taxanomy, physiology of extremophiles,

Morphology and Functions of Viruses, Yeast, Molds and Bacteria:

Viruses-Morphology of viruses- size, shape and symmetry, replication of viruses- Lytic and Lysogenic cycle,

Yeast and Molds: Morphology, life cycle, economic importance of yeast and Aspergillus,

Bacteria: Ultra structure of bacteria, cell wall, cell membrane, flagella, pili, capsule, endospore, and cell inclusions, differences between prokaryotic and eukaryotic cell,

Microbial growth: Definition of growth- growth curve, measurement of bacterial growth (cell number and cell mass) growth yield, continuous culture-chemostat, turbidostat, synchronous growth, effect of environmental factors on growth,

Microbial Nutrition and Control of Microorganisms: Nutritional requirements, nutritional types of bacteria, up-take of nutrients by cell, sterilization, and disinfection, effect of physical (moist and dry heat, radiation and filtration) and chemical agents, antibiotics- mode of action and resistance,

Methods in Microbiology: Culture media, synthetic and complex media, solidifying agents, types of media, isolation of pure cultures- spread plate, pour plate and streak plate, preservation of microorganisms, light (bright field only) and electron microscopy,

Applied Microbiology: Water, food and milk born contamination and remedy; basic microbial genetics- transformation, conjugation, transduction, strain improvement of industrially important micro-organisms.

Text Book:

'Microbiology', by Prescott L.M., Herley J.P., Klein D.A., McGraw- Hill

Reference Books:

1. "Microbiology", Pelzar, M.J., Chan, E.C.S., Kreig N.R., Tata McGraw-Hill

2. "Brock biology of Microorganisms", Madigan M.T.,Martinco J.M. and Parker J., Prentice Hall

BT-1106 WORKSHOP LAB

Course Objectives:

* Get hands on experience with the working skills in Carpentry trade.

* Know how to work with Sheet Metal tools.

* Get familiar with the working skills of Metal Fitting operations.

* Get hands on experience with house hold electrical wiring.

Course Outcomes:

* Can be able to work with Wood Materials in real time applications.

* Can be able to build various parts with Sheet Metal in day-to-day life.

* Can be able to apply Metal Fitting skills in various applications.

* Can be able to apply this knowledge to basic house electrical wiring and repairs.

syllabus

Carpentry: Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

Sheet Metal: Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

Fitting: Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

House wiring: Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

References Books:

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.
2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

BT-1107 PHYSICS LAB

Course Objectives:

* To enable the students to acquire skill, technique and utilization of the Instruments

* Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:

* Ability to design and conduct experiments as well as to analyze and interpret

* Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.
2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.
3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.
4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.
5. Determination of Refractive Index of Ordinary ray m---$_o$ and Extraordinary m---$_e$ ray.
6. Determination of Thickness Given Paper Strip by Wedge Method.
7. Calibration of Low Range Voltmeter.
8. Calibration of Low Range Ammeter.
9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.
10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.
11. Carey Foster's Bridge – Verification of laws of Resistance and Determination Of Specific Resistance.
12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.
13. Photoelectric cell-Characteristics.
14. Planks Constants.
15. Laser- Diffraction.

BT-1108 MICROBIOLOGY LAB

Course objectives:

* To provide the basic fundamental knowledge on growth of microorganisms

* To provide the basic fundamental knowledge on reaction of microorganisms with

* specific growth media

* To understand biochemical reactions with media used in identification.

Course outcomes:

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

* Explain the handling microbes and basic instrumentation used in Microbiological laboratory.

* Evaluate the growth and reaction of microorganisms on specific media

* Understand the staining and motility of microbes

* Differentiate the morphology of Fungi and yeast

* Evaluate quality of milk and water

List of Experiments:

1. Preparation of Nutrient broth and inoculation of Bacteria.
2. Preparation of Nutrient agar and inoculation of Bacteria
3. Isolation of pure cultures
4. Staining of Microbes- Simple staining, Gram staining, Negative staining, Capsule staining and spore staining.
5. Motility of Microbes.
6. Morphology of Fungi-(Aspergillusniger)
7. Morphology of Yeast-(Saccharomyces cerevisiae)
8. Bio-chemical tests- IMViC test, Amylase test, Hydrogen Sulphide production test
9. Testing of Microbiological quality of milk.
10. Testing of Microbiological quality of water.
11. Microbial assay of antibiotics.
12. Evaluation of disinfectant.

Text Book:

'Microbiology- a Laboratory Manual' by Cappuccino T.G., Sherman N, Addison

BT-1201 MATHEMATICS – II

Course Objectives:

* The way of obtaining rank, eigen values and eigen vectors of a matrix.

* To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes:

* Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors: Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications: Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Laplace Transforms:Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients -

Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43r^{d} edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

BT-1202 CHEMISTRY

Course Objectives:

* To apply the basic knowledge of Chemistry to the Engineering Discipline.

* To develop knowledge about water and its treatment for industrial and potable purposes.

* To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course outcome:

* This course applies the basic concepts and principles studied in Chemistry to Engineering.

* It provides an application of chemistry to different branches of engineering

* The students will be able acquire knowledge in the areas of Water Chemistry, Polymers, Corrosion, Fuels and Lubricants and nano materials and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Chemistry: Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Polymers and Plastics

Polymers: Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics of Polymerization Process. Plastics: Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Reinforced Plastics – Conducting Polymers.

Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion.

Corrosion Controlling Methods: Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants

Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications; Liquid Fuels: Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number; Gaseous Fuels: Biogas, LPG and CNG – Characteristics – Applications; Rocket Fuels: Propellants – Classification – Characteristics

Lubricants: Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials : Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

Text Books:

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.

2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

Reference Books:

1. Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut.

2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press

3. Engineering Chemistry - B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

BT-1203 ENGLISH

Course Objectives:

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts;

* To apply relevant writing formats to draft essays, letters, emails and presentations; and

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:

* Students will be able to analyse a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication; and

* Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

On the conduct of life: William Hazlitt

Life skills: Values and Ethics

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

Chindu Yellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar :

Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary :

Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing:

Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Writing: Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Book:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

References Books :

1. Practical English Usage, Michael Swan. OUP. 1995.

2. Remedial English Grammar, F.T. Wood. Macmillan.2007

3. On Writing Well, William Zinsser. Harper Resource Book. 2001

4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.

6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

BT-1204 'C'-Programing and Numerical Methods

Course Objectives:

* The course is designed to provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and Implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output. Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values, No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Book:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.

2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.

3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

BT-1205 GENETICS

Course Objectives:

* To introduce Mendel's law of inheritance.

* To introduce interaction of Genes and inheritance.

* To introduce Gene linkage, crossing over and mapping.

* To introduce sex determination & linkage.

* To introduce chromosomes & chromosomal variation.

Course Outcomes:

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

* Define inheritance and classify the types of inheritance.

* Different methods available to study genetics

* Performing of polymerized chain reaction, cloning and transformation

* Describe complementary, duplicate genes and interaction between different two gene pairs.

* Interpret sex determination mechanisms and inheritance of sex linked traits.

* Differentiate types of cytogenetic effects and numerical changes in chromosomes.

SYLLABUS

Mendel's law of Inheritance: Mendel's experiments–Mendels materials, crossing technique, results of Mendel's experiments, phenomenon of

dominance, variation in dominance relation, incomplete dominance, co-dominance, principle of segregation monohybrid cross, mechanism of segregation, monohybrid ratio, principle of independent assortment, Mendels dihybrid cross, mechanism of independent assortment, dihybrid ratio, back cross and test cross, deviations from dihybrid phenotypic ratio.

Interaction of Genes: Interaction of genes-combs in fowls, Epistasis, complementary genes, duplicate genes, additional interactions involving two gene pairs, interaction between more than two gene pairs.

Quantitative/Multiple factor inheritance: Multiple factors, quantitative and quantative traits, examples of quantitative inheritance, Kernel color in wheat, skin color in man, corolla length in tobacco, continuous variations.

Multiple Alleles: (Based on classical concept of Allelomorphism): Multiple alleles and isoalleles, skin color in rodents, eye color in Drosophila, self sterility in Nicotiana, blood groups in humans, complementation test or cis-trans test.

Linkage, crossing over and mapping: Linkage – coupling and repulsion hypothesis, Morgan's view on linkage, chromosome theory of linkage, kinds of linkage-complete linkage, incomplete linkage,linkage groups, significance of linkage.

Crossing over – Types of crossing over - mitotic and meiotic crossing over,mechanism - synapsis, duplication of chromosomes, crossing over by breakage and union, terminalization,

Molecular mechanism of recombination- Holiday model, cytological basis of crossingover; significance of crossing over.

Construction of a genetic mapping: Two point and three point test crosses and gene mapping, interference and coincidence.

Sex Determination: Genetically controlled sex determining mechanisms, sex chromosomal mechanism of sex determination, types-heterogenetic males, heterogenetic females, genic balance mechanism (X/A ratio in Drosophila), sex determination in man (TDF and SRY genes), sex determination in plants; Single gene control of sex; haploid males in hymenoptera; hormonal control of sex, environmental control of sex, dosage compensation (in man and Drosophila).

Sex Linkage: Inheritance of sex linked (X-linked) traits-eye color in Drosophila, haemophilia and color blindness in human and barred plumage in poultry, inheritance of Y-linked genes, inheritance of XY-linked genes, primary and secondary non-disjunction of sex chromosomes, sex influenced and sex limited traits, sex linked disorders in human beings.

CytoplasamicInheritance: Maternal effects-shell coiling in snails, pigment in flour moth, cytoplasmic inheritance involving dispensable heredity units, kappa particles in Paramecium, cytoplasmic inheritance by cellular organelles, plastid inheritance in variegated four-o-clock plant, mitochondrial inheritance, male sterility in plants, uniparental inheritance in chlymadomonas.

Chromosomal variations: Origin, types and cytogenetic effects,

Structural changes in chromosomes: Duplications, translocations, inversions (paracentric and pericentric cross over suppressors).

Numerical changes in chromosomes: Aneuploidy (monosomy, nullisomy, trisomy, tetrasomy), euploidy (monoploidy, haploidy, polyploidy-autopolyploids and allopolyploids).

Text Books:

1. "Genetics", by P.K.Gupta, Rastogi Publications

2. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology", by P.S. Verma & V.K. Agarwal, S. Chand & Company

Reference Books:

1. "Principles of Genetics", by E.J. Gardner, M.J.Simmons & D. Peter Snustard, John Wiley & Sons, INC. Publishing Co.

2. 'Essentials of Materials Science' by A.G. Guy.

3. An introduction to corrosion science and engineering By Herbert Uhilig and R. Winston Revie, Published by John Wiley and sons, New York

BT-1206 ENGLISH LANGUAGE LAB

Course Objectives:

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively; and

* To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

* A study of the communicative items in the laboratory will help students become successful in the competitive world;

* Students will be able to participate in group activities like roleplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

SYLLABUS

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.
2. Speak Well. Orient Blackswan Publishers, Hyderabad.
3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

BT-1207 CHEMISTRY LAB

Course Objectives:

* To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis

* To prepare and use ionexchange/ zeolite columns for the removal of hardness of water

* To develop the skill of organic synthesis through the preparation of a polymer/ drug

Course Outcomes:

* The course provides quantitative determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy

* The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water

* The course provides to synthesise a polymer or a drug

SYLLABUS

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ionexchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi.

BT-1208 CPNM LAB

Course Objectives:

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

* Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three

points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?

2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. a root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebraic equations.

BT-2101 BIOCHEMISTRY

Course Objectives:

* To study about the principles and significance of biochemistry.

* To study about the structure and function of Carbohydrates, Proteins and Aminoacids and Lipids.

* To study about the Nucleic acids like DNA and RNA and also to study about the structure and function of enzymes.

* To study about haemoglobin and chlorophyll molecules and their functions.

* To study about the fat soluble and water soluble vitamins also to study about the structure and function of harmones.

Course Outcomes:

At the end of the course, the students would be able to

* Define Biochemistry- study of chemical reactions and processes in living systems

* Understand Carbohydrates, Proteins and Amino acids and Lipids.

* Differentiate quantitative and qualitative analysis of the bio molecules.

* Demonstrate nucleic acids-DNA and RNA hereditary materials and enzyme structure and functions.

* Explain the basic structure of porphyrins and the detailed structure of haemoglobin and chlorophyll molecules.

* Describe the structure and function of vitamins and endocrinal glands.

SYLLABUS

Scope and importance of Biochemistry.

Carbohydrates: Classification, chemistry and properties of monosaccharides (Ribose, Glucose, and Fructose), disaccharides (maltose, lactose, sucrose) and polysaccharides (homopolysaccharides and heteropolys-accharides), metabolism of carbohydrates - glycolysis, TCA cycle, electron transport and oxidative phosphorylation, HMP shunt pathway, glycogenesis and glycogenolysis,

Proteins and amino acids: Classification and properties of amino acids and proteins, peptide bond, chemical synthesis of peptides and solid-phase peptide synthesis, structural organization of proteins- primary, secondary, tertiary and quaternary structure of proteins, denaturation of proteins,

Lipids: Classification, structure and physiological functions of triglycerides, fatty acids, phospholipids, cerebrosides, gangliosides and cholesterol, digestion and absorption of fats, biosynthesis and degradation of fatty acids and triglycerides,

Nucleic acids: Structure and properties of purines and pyrimidine bases, nucleosides, nucleotides, cellular localization, isolation and estimation of nucleic acids, types of nucleic acids, double helical structure of DNA, types of RNA, biosynthesis and catabolism of purines and pyrimidines,

Enzymes: Introduction, nomenclature and classification of enzymes, kinetic properties of enzymes, factors affecting enzyme action, coenzymes, enzyme inhibition- competitive, non- competitive and uncompetitive inhibitions,

Porphyrins: Chemistry of hemoglobin and chlorophyll, synthesis of heme and chlorophyll and heme catabolism,

Vitamins and hormones: Definition, classification, chemistry, source, functions and deficiency of vitamins, outlines of hormones and their functions,

Text Books:

1. "Fundamentals of Biochemistry" by J.L.Jain, S.Chand& Company Ltd, New Delhi

2. "Principles of Biochemistry" by Lehninger, Nelson and Cox, CBS Publications.

BT-2102 IMMUNOLOGY

Course Objectives:

To study about the process of immunity and organs and cells of lymphoid system.

* To study about the properties of antigens and structure and function of antibodies and various reactions of antigen and antibody.

* To study about complement system, major histocompatibility and various immune responses.

* To study about the hypersensitive reactions and their role in graft rejection and to study transplantation and various auto immune diseases.

* To study the hybridoma technology and to study the various vaccines and vaccination process.

Course Outcomes:

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

* Understand immunology, the structure and function of lymphoid organs and cells.

* Explain the process of antigenecity, and in the production of antibodies

* Describe precipitation, agglutination, and other antigen-antibody reactions so that student will become a good immunologist.

* Explain complement system and immune response –humoral and cell mediated and MHC (Majorhistocompatibility).

* Understand hypersensitive reactions, organ transplantations and various auto immune diseases.

* Demonstrate fusion of cells to produce hybrid cells (Hybridoma technology), Understand the method of vaccination.

SYLLABUS

Immunity, Lymphoid organs and cells: Introduction to Immunology and its origin in vertebrates and invertebrates, immunity-innate immunity and acquired immunity and the various lines of defence, organs of immune system, Thymus, bone marrow, bursa of fabricius, spleen, lymphnode and MALT, cells of immune system- B-cells, T-cells, antigen presenting cells, monocytes, NK cells and langerhan cells,

Antigens, Antibodies and Ag-Ab reactions: Antigens- properties of antigens, haptens, epitopes, T-dependent and T-independent antigens, adjuvants and their clinical importance, immunoglobulins- classification, structure and functions of immunoglobulins, antigenic determinants on antibodies, antigen – antibody reactions, and tests involving them - precipitation tests, agglutination tests, complement fixation tests, immunofluorescence, RIA, ELISA, Western blotting and ELISPOT,

Complement, MHC and Immune response: Complement system- its components, complement fixation pathways and consequences, MHC- In mice and human, structure of MHC molecules and their role in antigen presentation, immune response- humoral and cell, mediated immune response, IR curve, role of cytokines in immunity, interferons and interleukins, immune suppression, immune tolerance,

Hypersentivity, Transplantation, Autoimmune disease: Hypersensitive reactions- Type I, II, III and IV reactions and their role in graft rejection, transplantation immunology- classification of grafts and immunology of graft rejection, agents used for preventing graft rejection, autoimmune diseases- definition and few examples,

Hybridoma and Vaccination: Hybridoma technology- production of monoclonal antibodies and their applications, vaccines and vaccination, methods of attenuation of live forms, types of vaccines- whole organisms as vaccines, attenuated forms, purified molecules as vaccines, recombinant organisms, DNA vaccines and synthetic peptides.

Text Books:

1. 'Immunology' by A.Goldsby, Thomas J.Kindt, Barbara A.Osborne and Janis Kuby

2. 'A Text book of Microbiology' by R.Ananthanarayan and C.K.J.Pandey.

BT-2103 BIO-ANALYTICAL TECHNIQUES

Course Objectives:

* The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, Mass, GC, HPLC, different chromatographic methods and other important topics will be taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to theoretical aspects, the basic practical knowledge relevant to the analysis will also be imparted.

Course Outcomes:

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

* Explain general principles and theory of the Spectroscopy.

* Understand the basic instrumentation of HPLC, GLC for identification and characterization of compounds.

* Learn various separation techniques.

* Analyze instrumentation, separation and identification of compounds by Electrophoresis.

SYLLABUS

Chromatographic Techniques - Affinity - Adsorption - paper - Thin layer - Column - Ion Exchange - Gel Chromatography - Applications. Gas liquid chromatography - High Pressure liquid chromatography - Equipment - Applications. Spectrophotometric Techniques - IR - UV - Visible - NMR - ESR - Optical density - Circular dichroism.

pH - pH titrations - Determination of pKa values - Buffers - Preparation - Buffer Action - Physiological buffers - potentiometric titration - centrifugal dialysis - lyophilization - Electrophoresis - Ultra filtration - Assay techniques for proteins, lipids, sugars, amino acids and nucleic acids.

Text Books:

1. " Instrumental methods of Chemical Analysis - Chatwal, G & Anand, S. Himalaya Publishing House, Bombay.

2. "Instrumental methods of Chemical Analysis - Sharma, B.K. Goel Publishing House, Meerut.

3. "Instrumental Methods Analusis - Willard, Merritt, Dean& Settle, CBS Publishers & Distributors, Delhi.

BT-2104 DOWNSTREAM PROCESSING

Course Objectives:

The course will help to:

* Learn the fundaments of downstream processing

* Understand the principle, working and application of major unit operations in Bio processing of industrially important products.

* Understand strategies for development of novel Bio processing protocol by applying the concise principles of downstream processing.

Course Outcomes:

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

* Apply the concepts of downstream processing for separation.

* Execute precise and efficient bio separation process, which is cost effective and yield high degree of pure substance.

* Select the bio separation process which gives high resolution, economical bio products.

SYLLABUS

Cell Disruption: Physical and Mechanical methods, Chemical and Enzymatic methods.

Separation Of Insoluble Products: Filtration, Centrifugation, Coagulation and Flocculation, Sedimentation.

Separation Of Soluble Products: Extraction, Precipitation, Adsorption, Micro filtration, Ultra-filtration,Reverse Osmosis,Dialysis, Electro Dialysis, Pervaporation. Electrophoresis, Gel Exclusion Chromatography and Ion Exchange Chromatography.

Products Purification & Polishing: Crystallizationand Drying.

Text Books:

1. "Bioseparations–principles & techniques" by B.Siva Sankar.

2. "Bioprocess Engineering" by Michael L.ShulerFikretKargi, Prentice Hall of India

3. "Bioseparations – downstream processing for Biotechnology", by Paul A Belter and E.L.Cussler.

Reference Books:

1. "Biochemical engineering fundamentals" 2nd ed. by J E Bailey and D Ollis, McGraw- Hill (1986).

2. "Principles' of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press (1984).

BT-2105 MANAGERIAL ECONOMICS

Course Objectives:

* To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.

* To understand the Micro and Macro Environment of Business.

* To familiarise the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

* Managerial Economics will help the prospective engineers, who are likely to occupy managerial positions in future to understand the various economic activities in business and industry for an effective and efficient running of the organizations.

SYLLABUS

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand Analysis :Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve. Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand. Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations.

Theory of Production and Cost analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law. Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale.

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly, Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

Pricing Analysis : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark-down pricing of retailers.

Business cycles, Inflation and Deflation:

Business cycles - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles. Inflation -Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures. Deflation- Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

Text Books:

1. Managerial Economics by Sankaran,S., Marghan Publications, 2015, Chennai.

2. Managerial Economics and Financial Analysis by Aryasri, A.R., MC Graw Hill Education, New Delhi,2015.

BT-2106 BIOCHEMISTRY LABORATORY

Course objectives:

* This lab has been designed for the better understanding of biochemistry and to estimate the amount of biomolecules from biological substances and to prepare the buffers required to conduct laboratory sampling & testing. Further this lab also fulfills the Skills required in various biotechnology & food processing industries.

Course out comes:

* At the end of the course, the students will achieve the following out comes.

* Gains good knowledge & skills in biochemistry field for better understanding Biomolecules & biochemical techniques.

* Prioritise Biochemistry related experiments in the research field of Biotechnology.

* Able to handle various instruments related to biochemistry.

* In the industry and in the scientific laboratory, professionally can do work independently.

* Develop the knowledge to extract, estimate the biomolecules and report the data in the field of biochemistry & biotechnology research.

List of Experiments:

1. Preparation of Acetate Buffer
2. Preparation of Phosphate Buffer
3. Estimation of glycine by Sorenson's formal method .
4. Estimation of Reducing sugar with Benedicts Quantitative Reagent.
5. Preparation of calcium alginate beads.
6. Paper chromatography technique to separate biomolecules.
7. Estimation of glucose using 3,5- dinitrosalicylic acid (DNS) method.
8. Estion of total carbohydrates using anthrone method.
9. Estimation of proteins using Lowry method.
10. Estimation of proteins using biuret method

BT-2107 BIOANALYTICAL TECHNIQUES LABORATORY

Course Objectives

* Many scientific endeavors are dependent upon accurate quantification of drugs and endogenous substances in biological samples; the focus of bioanalysis in the pharmaceutical industry is to provide a quantitative measure of the active metabolite(s) for the purpose of pharmacokinetics, toxicokinetics, bioequivalence and exposure–response (pharmacokinetics/ pharmacodynamics studies). Modern drugs and bio molecules are more potent, which require more sensitive bioanalytical assays to accurately and reliably determine at lower concentrations.

Course Outcomes:

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

* Apply principles of various spectroscopic techniques.

* Identify compounds and their functional groups using HPLC.

* Select and apply various analytical techniques.

* Apply the technique of electrophoresis.

List of Experiments:

1. Determination of given sample using UV Visible Spectrophotometry.
2. Identification of given sample using Paper chromatography
3. Identification of given sample using Thin layer chromatography
4. Separation of proteins by SDS PAGE Electrophoresis technique.
5. Separation of bio molecules using Ion exchange chromatography
6. Instrumentation & Working of HPLC
7. Identification of bio molecules by HPLC
8. Estimation of pigments using Colorimetric methods.

BT-2108 DOWNSTREAM PROCESSING LABORATORY

Course Objectives:

The objective of this course is to enable students to

* Acquire knowledge of different techniques for solid-liquid separation, product release and purification of Biotechnology products.

* To design and execute efficient and sustainable downstream processes to achieve a pure bioproduct.

Course Outcomes:

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

* Understand the fundamentals of recovery/ purification operations for bio pharmaceutical production.

List of Experiments

1. Cell Disruption by Sonication
2. Cell Disruption by Enzymatic Reaction
3. Centrifugal Separation- Ultra Centrifugation, Gel Filtration
4. Micro filtration
5. Ultra filtration
6. Aqueous Two-phase Extraction
7. Dialysis

BT-2109 MATLAB

Course Objectives:

* The student will learn to apply the knowledge of MATLAB for solving Chemical Engineering problems.

Course Outcomes:

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

* Apply Matlab to create and print arrays and execute function files

* Solve linear equations using Matlab

* Determine the curve fit equation for the given data

* Draw 2D plots and 3D plots for the given data

SYLLABUS

Introduction, Tutorial lessons: MATLAB session, working with arrays of numbers, creating and printing simple data, saving and executing a script file, creating and executing function files, working with files and directories. Interactive computation - Matrices and vectors, matrix and array operations, creating and using inline functions, using built in functions and online help, saving and loading data, plotting simple graphs. Script files, function files, language specific features, advanced data objects.

Applications - linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration, ordinary differential equations, nonlinear algebraic equations.

Basic 2D plots, using subplot to layout multiple graphs. 3-D plots, symbolic Math tool box: two useful tools in symbolic Math tool box, using symbolic Math tool box.

Text Book:

'Getting started with MATLAB: A quick introduction for scientists and engineers' by Rudra Pratap, Oxford University press.

BT-2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

The objective of the course is:

* Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

* This course will illuminate the students in the concepts of laws and its applicability to engineers Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

* Strengthening of self-reflection, Development of commitment and courage to act and also enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and professional lives

* To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives

* The students will learn the rights and responsibilities Individual, employee, team member and a global citizen

Course Outcomes:

By the end of the course Student will be able to:

* Grasp the meaning of the concept – Law and also Get an overview of the laws relating to Engineers and also Apprehend the importance of being a law abiding person and They would have better critical ability

* Self-explore by using different techniques to live in harmony at various levels

* Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life

* Students are expected to become more aware of themselves and their surroundings (family, society, nature)

* They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

* They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education: Self-Exploration–what is it ? - Its content and process; 'Natural Acceptance' and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking, Include practice sessions and case studies.

Understanding Harmony in the Human Being - Harmony in Myself!: Understanding human being as: a co-existence of the sentient 'I' and the material 'Body', the needs of Self ('I') and 'Body' - happiness and physical facility, the Body as an instrument of 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, P to ensure Sanyam and Health, Include practice sessions and case studies.

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship: Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

Concept of Law and Law of Torts: Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations, Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities/Duties Hiring Practices, Introduction to Intellectual Property Law, Professional Code of Conduct for Engineers, Relationship between Law and Ethics, Include practice sessions and case studies.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic

Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Include practice sessions and case studies.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

3. R. Subramanian, "Professional Ethics", Oxford University Press.

4. S.B. Srivasthva, "Professional Ethics & Human Values", SciTech Publications (India) Pvt. Ltd. New Delhi.

5. D.R. Kiran, "Professional Ethics & Human Values", TATA Mc Graw Hill Education.

6. Saroj Kumar, "Business Law" and Avtar Singh, "Law of Contract"

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

2. The Story of Stuff (Book), Mohandas Karamchand Gandhi "The Story of My Experiments with Truth", E. FSchumacher. "Small is Beautiful", Slow is Beautiful –Cecile Andrews, J C Kumarappa "Economy of Permanence", Pandit Sunderlal "Bharat Mein Angreji Raj" and Dharampal, "Rediscovering India

3. G K Kapoor, "Business Law" and Sen & Mitra, "Business & Commercial Laws" and Calvin Frank Allen, "Business law for Engineers"

4. Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). Introduction to Psychology. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

5. Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi

6. Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.

7. Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, "Engineering Ethics, Concepts Cases: 4e, Cengage learning, 2015.

8. Caroline Whitbec, " Ethics in Engineering Practice & Research: 2e, Cambridge University Press 2015.

BT-2111 NCC/NSS

All the students should enroll either in NCC or NSS and get a satisfactory report.

BT-2201 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Objectives:

* To provide the students with knowledge of fundamental laws in electrical Engineering

* The ability to formulate and solve the differential equations describing time behavior of circuits containing energy storage elements.

* The capability to design and construct circuits, take measurements of circuit behavior and performance, compare with predicted circuit models and explain discrepancies.

* To understand the working of various D.C Machines.

* To inculcate the understanding about the AC fundamentals.

* To provide an insight into the principles of working of transformers, dc machines, alternators and induction motors.

* An understanding of how complex devices such as semiconductor diodes and field- effect transistors are modeled and how the models are used in the design and analysis of useful circuits.

* Understand the characteristics of transistors in CE, CB, CC configuration and it's usage as an amplifier and oscillator.

Course Outcomes:

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

* Understand concept source of electrical generation, transmission, distribution, protection, safety measures and power & energy measurement.

* Understand construction & working of electrical machines and evaluate their performance

* Explain theconstructional details, principle of operation, Performance, startersand speed control of DC Machines, AC Machines and Transformers

* Develop and employ circuit models for elementary electronic components like semiconductor diodes and transistors

SYLLABUS

Section - A

Fundamentals Laws and Theorems: KVL, KCL, ohm's law, superposition theorem, Thevenin's theorem, Norton's theorem, reciprocity theorem, D.C. and A.C. Circuits: Mesh analysis, nodal analysis, star-delta transformation, sinusoidal steady state analysis of 1-ö circuits, series and parallel circuits, 3-ö circuits, Star-Delta circuits,

D.C. Machines :Construction and working of D.C. generators, EMF equation, classification, characteristics, armature reaction, construction and working of D.C. motors, torque equation, characteristics, speed control methods and 3-point starter, efficiency calculation,

Single phase Transformers: Construction and working of single phase transformers, equivalent circuits, efficiency, regulation, O.C and S.C tests,

A.C. Machines: Construction and working of 3 – ö Induction motor, slip, torque equation, efficiency, calculation, construction and working of synchronous generator (alternator), EMF equation, regulation-synchronous impendence method, synchronous motor, torque equation, starting methods.

Section-B

Electronics: Chartersistics of semiconductor diodes, transistors, characteristics of CB, CE, CC transistor configurations, oscillators, cathode ray oscilloscope, construction, working, applications, mechanical transducers, electrical transducers, pressure gauges, LVDT.

Text Books:

1. 'Elements of Electrical Engineering and Electronics' by V.K. Mehta, S.Chand& Co.

2. 'Fundamentals of Electrical Engineering and Electronics' by B.L.Thereja

3. 'Electronic Devices and Circuits' by Allen Mottorshad, Prentice Hall of India

4. 'Basic Electrical Engineering' by V.N. Mitthal, Tata Mc-Graw Hill

BT-2202 MATERIAL & ENERGY BALANCES

Course Objectives:

* To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

Course Outcomes:

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

* Convert physico-chemical quantities from one system of units to another

* Identify basis and degrees of freedom

* Perform material and energy balances on single units without and with chemical reactions

* Solve the material and energy balance problems on multi-unit processes with recycle, purge and bypass

* Analyze the ideal and real behavior of gases, vapors and liquids

SYLLABUS

Stoichiometry and composition relationships- the gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales,

Behavior of ideal gases- application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis,

Vapor pressures- Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes,

Humidity - Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature,

Material balances- Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge,

Heat capacities of gases and gaseous mixtures- effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity,

Standard heat of reaction - Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non- adiabatic reactions, theoretical and actual flame temperatures.

Text Book:

'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference Books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995

2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)

3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

BT-2203 FLUID MECHANICS AND PARTICLE TECHNOLOGY

Course objectives

To provide

* Knowledge on pressure distribution in static fluids.

* Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.

* Knowledge of incompressible fluid flow in pipes

* Knowledge on pipes, fittings, transportation and metering devices.

* To make the students exposed to different geometrical sizes of particles of raw materials used in the industries, area of calculation of the particles w.r.t their sizes

* To get familiarity with the different laws of grinding

* To know the movement of particles in different liquids (viscous) and filtration techniques

Course Outcomes:

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

* Estimate the pressure drop.

* Calculate the pumping capacity and friction losses of flowing fluids.

* Differentiate pumps based on their performance.

* Select proper measuring device and estimate the quantity of flow.

* Syllabus Select suitable size reduction equipment based on performance and power requirement.

* Analyze particle size distribution of solids

* Evaluate solid-fluid separation equipment

SYLLABUS

Fluid Mechanics : Fluid statics and applications: Units and Dimensions, Dimensional Homogeneity, Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.

Fluid Flow phenomena: Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.

Basic Equations of Fluid Flow: Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

Incompressible flow in pipes and channels : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen- Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

Transportation of Fluids: Pipes, fittings, valves, positive displacement pumps (reciprocating, rotary and peristaltic pumps), centrifugal pumps

Metering of fluids: Full bore meters – Venturi meter, Orifice meter and Rotameters.

Particle Technology: Properties and handling of particulate solids – characterization of solid particles, average particle size, screen analysis- Conceptual numerical of differential and cumulative analysis. Size reduction – characteristics of comminuted products, crushing laws, working principle of ball mill., Mixing – types of mixers (ribbon and muller mixer), power number and power number calculation; Filtration & types, filtration equipments (plate and frame, rotary drum) conceptual numerical

Flow past immersed bodies – drag and drag co-efficients, application of Kozney Karmen & Burke Plummer equation; Flow through stagnant fluids – theory of Settling and Sedimentation – Equipments (cyclones, thickners) conceptual numerical, Particle size enlargement

Text Book:

"Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Book:

"Introduction to Chemical Engineering" by W L Badger and J T Banchero, Tata Mc Graw Hill

BT-2204 BIOCHEMICAL THERMODYNAMICS

Course Objectives:

* To understand the theory and applications of classical thermodynamics, thermodynamic properties, equations of state, methods used to describe and to predict phase equilibria and chemical reaction equilibrium.

Course Outcomes:

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

* Understand the laws of thermodynamics

* Understand the degrees of freedom and phase & chemical reaction equilibria

* Calculate thermodynamic parameters involved in biochemical reactions

* Differentiate between ideal and non-ideal solutions

SYLLABUS

The first law and other basic concepts: Internal energy, the first law of thermodynamics, thermodynamics state and state functions, enthalpy, the Steady state Steady flow process, the reversible process, constant V and constant P processes.

Heat effects: Latent heats of pure substances, standard heat of reaction, standard heat of formation, standard heat of combustion.Temperature dependence of heat effects of chemical reactions.

The second law of Thermodynamics: Statement of the second law, heat engines, entropy changes of an ideal gas, mathematical statement of second law, the third law of thermodynamics.

Thermodynamic properties of fluids : Property relations for homogeneous phases, residual properties, Solution thermodynamics : partial properties, concepts of chemical potential and fugacity, ideal and non-ideal solutions, Gibbs-Duhem equation, excess properties of mixture, activity coefficients and correlations.

Criteria for phase equilibria: Vapour-liquid equilibrium calculations for binary mixtures, Liquid-liquid equilibria and solid liquid equilibria, Chemical reaction equilibria.

Biochemical thermodynamics: Energetics of metabolic pathways, Energy coupling (ATP & NADH), Energetic analysis of cell growth and product formation. Thermodynamics of microbial growth, oxygen consumption and heat evolution in aerobic cultures, energy balance equation for cell culture.

Text Books:

1. Introduction to Chemical Engineering Thermodynamics by J.M. Smith, H.C. Van Ness and M.M. Abbott, 6th Ed. McGraw-Hill, 2000.

2. Kinetics and Energetics in Biotechnology, J.A. Roels, Elsevier, 1983.

Reference Book:

1. Chemical Engineering Thermodynamics, Y.V.C. Rao, University Press.

BT-2205 PLANT CELL AND TISSUE CULTURE

Course Objectives:

* To know the basics of plant tissue culturing.

* To know the production of callus from carrot.

* To measure the efficacy of root and shoot.

* To develop the graduate capabilities of knowledge ability, comprehension and applications of plants in cell and tissue culture systems.

* To know how cell and tissue culture contributes to global sustainability.

* To develop the practical skills and confidence of students to successfully culture plant cells and tissues.

Course Outcomes:

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

* Explain the various components of plant tissue culture media, e.g. minerals, growth factors, hormones, and what governs the choice of components

* Describe the various steps taken to establish and optimize media for particular purposes in particular species, without the aid of texts.

* Demonstrate and perform some of the more advanced techniques, e.g. embryo rescue, and protoplasting.

* Establish and maintain plants in tissue culture and micropropagation, including morphogenesis.

* Understand the various cell lines used in tissue culture and their origins and uses.

SYLLABUS

Fundamentals of plant tissue culture: laboratory organization, sterilization methods, culture medium and growth regulators. Totipotency, callus culture and organogenesis- Expression of totipotency in cell culture and importance; Principle of callus culture, characteristics of callus culture and importance; Principle of organogenesis, factors effecting organogenesis and applications.

Cell culture: single cell culture-isolation, methods of single cell culture and importance; Cell suspension culture, types of suspension culture, growth pattern, synchronization, assessment of growth and viability of cultured cells, significance of suspension cultures.

Somatic embryogenesis and synthetic seeds: principle, induction of embryogenesis, embryo development and maturation, factors effecting somatic embryogenesis, synchronization, large scale production and importance of Somatic embryogenesis, synthetic seeds- methods of making synthetic seeds and applications.

Germplasm conservation Somoclonal variations – its genetic basis and application in crop improvement- cell line selection for resistance to herbicides, stress and diseases. Haploid production and its advantages- androgenesis, principle, pollen culture, advantages of pollen culture over anther culture, homozygous diploids, importance of anther and pollen culture.

Clonal propagation –technique- multiplication by axillary and apical shoots, adventitious buds/bulbs/protocorms, by callus culture, transplantation, acclimatization

Production of disease free plants- meristem tip culture- virus indexing.

Protoplast technology- isolation, culture and plant regeneration, protoplast fusion, methods, identification and characterization of somatic hybrids, cybrids and importance of somatic hybridisation.

Genetic transformation – plant vectors – Ti plasmids, Ri plasmids - indirect and direct methods, current status and limitations.

Automation and Economics of tissue culture.

Text Book:

Plant tissue culture – Kalyan Kumar De – New Central Book Agency

Reference Books:

1. An Introduction to Plant tissue culture. Razdan. M. K., Oxford & LBH.
2. Plant tissue culture- theory and practice. Bhojwani, SS &Razdan, MK.Elsevier
3. Plant tissue and Cell culture. Street, HE.Blackwell

BT-2206 FLUID MECHANICS AND PARTICLE TECHNOLOGY LABORATORY

Course Objectives:

* The student will be exposed to various fluid measuring devices and pumps. The pressure drop calculation experimentally across the pipe and packed bed will also be dealt in this lab.

* The student is introduced to the concepts of sampling, processing of solid raw materials. The student also gets hands on training on operating various machines used for processing of solids.

Course Outcomes:

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

* Distinguish laminar and turbulent flows.

* Determine the characteristics of flow meters

* Determine the characteristics of packed beds and centrifugal pumps

* Calculate pressure drop across a pipe

* Select suitable methods for size reduction of minerals or other intermediates

* Analyze particle size distribution of solids

* Evaluate suitable mechanical separations of solid-liquid.

List of Experiments

1. Variation of orifice coefficient with Reynolds number Friction loses for flow through pipe.
2. Calibration of Rotameter
3. Verification of Bernoullis Theorem
4. Pressure drop in a packed bed for different fluid velocities
5. To study the characteristics of a centrifugal pump
6. Batch sedimentation
7. Ball Mill
8. Cyclone separator /Trommel
9. Leaf / Pressure filter/Sampling techniques
10. Screen analysis/effectivenes

BT-2207 PLANT CELL AND TISSUE CULTURE LABORATORY

Course Objectives:

* To acquaint students with the principles, technical requirement, scientific and commercial applications of Plant Tissue and Cell culture.

* To expose students to supporting methodologies of plant tissue and cell culture, micro propagation techniques and applications of Tissue and Cell culture to plant improvement.

Course Outcomes:

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

* Develop and maintain cultures of animal cells, establish cell lines with good viability, minimal contamination.

* Perform supportive tasks relevant to cell culture, including preparation and evaluation media.

* Recognize and troubleshoot problems, common to routine cell culture.

List of Experiments

1. Sterilization methods
2. Preparation of stock solutions
3. Preparation of medium
4. Establishment of callus cultures from carrot cambial explants
5. Establishment of cell culture
6. Establishment of growth and preparation of growth curve
7. Embryo culture of maize or any suitable crop, root/shoot initiation (organogenesis) from different explants
8. Micro propagation and plant regeneration
9. Isolation, culture and fusion of plant protoplasts
10. Anther and pollen culture

BT-2208 ASPEN PLUS (Process Design)

Course Objectives:

* To familiarize students with basic programming skills required for solving chemical engineering problems.

* To analyze the data obtained from simulation with theoretical concepts.

* To compare different thermodynamic property estimation methods and analysing the results.

* To familiarize students with fundamental applications of chemical engineering in ASPEN PLUS.

Course Outcomes:

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

* Carry out thermodynamic property estimations using Aspen

* Simulate Mixer, splitter, pumps, compressors and flash units

* Apply sensitivity, design specification and case study tools in Aspen

* Design heat exchangers, reactors and distillation columns

* Optimize process flowsheets using sequential modular and equation oriented approaches.

SYLLABUS

Solve the following steady state simulation exercises using Aspen:

1. Physical property estimations.
2. Simulation of individual units like, mixers, splitters, heat exchangers, flash columns and reactors
3. Design and rating of heat exchangers
4. Design and rating of distillation columns.
5. Mass and Energy balances.
6. Handling user specifications on output streams – Sensitivity and design Spec tools.
7. Simulation of a flowsheet
8. Simulation exercises using calculator block
9. Optimization Exercises
10. Simulation using equation oriented approach

Text Books:

1. Lab manuals / Exercise sheets
2. A.K.Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 3rd Edition, 2018.

BT-2209 ENVIRONMENTAL SCIENCE

Course Objectives:

* The aim of this course is to make the students better understand the changes in the environment and be given a greater voice and planning conservation through an interdisciplinary environmental science curriculum that is design to enhance scientific enquiry and to strengthen competence.

Course Outcomes:

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

* Understand various types of pollution regulations and their scientific bases.

* Apply knowledge for the protection and improvement of the environment.

* Recognize the major concepts in environmental science and demonstrating in-depth of the environment

SYLLABUS

Introduction: Definition, scope and importance, measuring and defining environmental development – indicators

Ecosystems: Introduction, types, characteristic features, structure and functions of ecosystems – forest, grassland, desert, aquatic (lakes, rivers and estuaries)

Environmental and natural resources management : Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems Forest resources- use and over-exploitation, mining and dams –their effects on forest and tribal people Water resources – use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits

and costs, conflicts over water Energy resources- Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment

Bio-diversity and its conservation: Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation

Environmental pollution- local and global issues: Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion

Environmental problems in India: Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management

Economy and environment: The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment

Social issues and the environment: Population growth and environment, environmental education, environment movements, environment versus development

Institutions and governance: Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act, environment .protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environmental governance

International conventions: Stockholm conference-1972, Earth summit-1992, World commission for environmental development (WCED)

Case studies: Chipko movement, Narmada bachaoandolan, Silent valley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare), Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh

Field work: Visit to a local area to document and mapping environmental assets – river/forest/grass land / hill/ mountain, study of local environment-common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants

Text Book:

Environmental Studies by Anubha Kaushik & C.P. Kaushik, Second Edition, New Age International (P) Limited.

BT-3101 HEAT AND MASS TRANSFER

Course Objectives:

* To explain the students with the basic principles of heat and mass transfer operations

* To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer components from one phase to other phases.

* To describe the students with equipment used in operations involving heat and mass transfer and their advantages and disadvantages.

* To focus on heat exchangers and distillation operations and the process design aspects of the same operations.

Course Outcomes:

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

* Define the basic principles of heat and mass transfer operations and other thermal and separation processes.

* Identify the basic techniques for measurement of diffusivity, mass transfer coefficient, heat transfer coefficients.

* Understand the importance of heat and mass transfer phenomena in the design of process equipment

* Understand the VLE concepts and its application to various types of distillation.

* Identify the major parts of various Heat and mass transfer equipments.

SYLLABUS

Nature of heat flow - Conduction, convection and radiation Heat transfer by Conduction: Basic law of conduction, thermal conductivity, steady state conduction, compound resistances in series, heat flow through a cylinder and a sphere, unsteady state conduction – one dimensional heat flow with constant surface temperature.

Principles of heat flow in fluids: countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, LMTD, individual heat transfer coefficients, fouling factor.

Heat exchange equipment: Double pipe heat exchanger and 1-2 Shell and tube heat exchanger

Molecular diffusion in fluids: Binary solutions, Fick's law, Steady state diffusion in A diffusing through non-diffusing B and equimolal counter diffusion, application of molecular diffusion. Mass transfer coefficients, theories of mass transfer, analogy between momentum, heat, and mass transfer. Concept of equilibrium, diffusion between phases, two resistance theory.

Absorption: Solubility's of gases in liquids, ideal and non-ideal solutions, choice of solvent for absorption,.

Distillation: Principles of VLE for binary systems, relative volatility, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe- Thiele method, Murphy stage efficiency.

Equipment for gas-liquid operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, spray towers, sieve tray for absorption and distillation, packed towers for absorption and distillation, tray towers versus packed towers.

Text Book:

1."Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

2. Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference Books:

1. Process Heat Transfer, by D. Q. Kern, Tata McGraw Hill, New Delhi.

2."Unit Operations in Chemical Engineering" by Mc Cabe,W.L., Smith,J.C. and Harriot, P., 5th Edition, McGraw-Hill Book Co.,

BT-3102 ENZYME ENGINEERING

Course Objectives:

* To understand the IUBMB system of enzyme classification and to know the catalytic activity and its regulation.

* To identify the sources and produce the enzymes with greater concentration.

* To learn the kinetics of single enzyme substrate catalyzed reactions, enzyme inhibition kinetics and the factors affecting the enzyme activity.

* To gain knowledge in the enzyme immobilization methods and their kinetics.

* To design the reactors.

* To use the enzymes in various industries.

Course Outcomes:

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

* Understand the enzyme structure and classify them.

* Produce the enzyme with high purity.

* Identify the kinetics and optimize the factors that affect the enzyme activity for maximum production.

* Describe the immobilization of the enzymes to produce an enzyme for industrial and other applications.

SYLLABUS

Introduction: Catalysis and biocatalysis, enzyme structure functionality and relationship, enzyme activity, classification of enzymes, enzymes as process catalysts.

Enzyme Production: Enzyme sources, synthesis, recovery, purification, and formulation of enzymes,

Homogeneous Enzyme Kinetics: Hypothesis of enzyme kinetics, rapid equilibrium and steady-state hypothesis, determination of kinetic parameters, various types of enzyme inhibitions, effect of pH andtemperature.

Heterogeneous Enzyme Kinetics: Various methods of enzyme immobilization, mass transfer effects in heterogeneous biocatalysis, partition effects, external (film) diffusion, internal (pore) diffusion.

Enzyme Reactors: Design of ideal reactors with enzymes (Batch, CSTR, PFR), effect of diffusion on enzyme reactor design, effectiveness factor, thermal inactivation.

Application of Enzymes: Application in biosensors, Food processing applications, Medical and pharmaceutical applications, application of immobilized enzymes.

Text Books:

1. "Enzyme Technology" by M.F.Chaplin and C.Bucke, Cambridge University press, 1990.

2. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi, 2002.

Reference Books:

1. "Biocatalysts and Enzyme Technology" by K. Buchholz,V.Kasche and U.T. Bornscheur, Wiley,2005

2. "Enzyme Technology", by Shanmugam,S. and Satish Kumar,T.,IK International Pvt. Ltd, New Delhi, 2008

3. "Biochemical Engineering Fundamentals' by Bailey,J.E., and Ollis,D.F., McGraw- Hill,1986.

4. "Enzyme Biocatalysis: Principles and Applications' by A.Illanes, Springer.

BT-3103 CELL AND MOLECULAR BIOLOGY

Course Objectives:

* The main objective is to prepare the students for career in fields that require advance knowledge of cell and molecular biology.

* With the application of study in cell and molecular biology, the student can also provide services and economic opportunities to the communities.

Course Outcomes:

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

* Understand and utilize the scientific vocabulary used in communicating information in Cell & Molecular Biology.

* Represent and illustrate the structural organization of genes and the control of gene expression.

* Develop basic knowledge and skills in Cell & Molecular Biology

* Outline the processes that control eukaryotic cell cycle and cell death.

* Conduct research in the frontier and multi disciplinary areas of modern biology.

SYLLABUS

The nucleus, chromatin and the chromosome: structure and function of nucleus; organization of genetic material – Packing of DNA into chromatin, Nucleosome organization; Chromosome structure; Cell cycle – Check points, Cdks and regulation.

The biochemical basis of Inheritance: DNA as the genetic material, DNA structure and replication in prokaryotes and eukaryotes – Enzymes involved and mechanism, including replication at telomere.

Genetic code: properties of genetic code, Wobble hypothesis.

Gene Expression:Transcription in prokaryotic and eukaryotic systems – enzymes and factors involved and mechanism; RNA processing in eukaryotes – capping, addition of poly(A) and removal of introns; Translation in prokaryotes and eukaryotes – machinery involved and mechanism; Regulation of gene expression in prokaryotes – Lac operon concept in E.coli ; regulation of gene expression in eukaryotes by promoters, enhancers, silencers and transcription factors.

Mutations – Terminology, types of mutations, Biochemical basis of mutants, Mutagenesis, Chemical mutagens - base analogues - Intercalating substances, Physical mutagens- U.V radiation and ionization radiation, AMES test - Repair of DNA damage.

Text Book:

"The world of the cell" Becker, Klein smith &Hordin, Pearson education

Reference Books:

1. Molecular cell biology by Lodishet.al . Freeman Publications
2. "Cell & Molecular Biology", De.Roberties. E.D.P., International Edition
3. "Molecular Biology", Friefelder, D., Narosa publications
4. "Molecular Biology of the Gene", J.D.Watson et.al, Banzamin

BT-3106 HEAT AND MASS TRANSFER LABORATORY

Course Objectives:

* The student will calculate heat transfer coefficients for both natural and forced convection scenarios. The student will conduct experiments to calculate emissivity of the given plate.

* The student will learn about the LLE, dynamics and mass transfer in spray tower, packed tower and sieve tray tower.

Course Outcomes:

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

* Determine the thermal conductivity of composite walls and heat transfer coefficients in different systems

* Determine the emissivity of the given test plate

* Determine the mass transfer coefficient in solid diffusing into air

* Determine the diffusivity coefficient in two liquids systems/liquid vaporizing in to air

* Evaluate evaporation rate of water and mass transfer coefficient in it

* Evaluate performance steam distillation

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of forced convective heat transfer coefficient for air flowing through a pipe.
3. Determination of emissivity of a given plate at various temperatures.
4. Determination of over-all heat transfer coefficient in double pipe heat exchanger.
5. Determination of radiation constant of a given surface.
6. Determination of liquid diffusion coefficient
7. Determination of vapor diffusion coefficient
8. Surface evaporation
9. Steam distillation
10. Vapour liquid Equilibria

BT-3107 CELL AND MOLECULAR BIOLOGY LABORATORY

Course Objectives:

* The students will learn the fundamental aspects of experimental cell and molecular biology

Course Outcomes:

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

* Understand the basics of techniques to study molecular biology.

* Comprehend the structures of the major classes of macromolecules.

* Handle PCR

List of Experiments:

Cell biology: Study of mitosis, meiosis, differential staining of euchromatin and heterochromatin, florescent in situhybridisation - FISH (principle & photographs),

Molecular biology: Isolation of genomic DNA, quantification of DNA, Agarose gel electrophoresis, isolation of plasmid DNA, restriction digestion, ligation, transformation, southern blotting, isolation and analysis of RNA.

Text Books:

1. "A Guide to Molecular Cloning", Vol. 1,2 & 3, Sambrook, J. et al., Cold Spring Harbor Laboratory Publications

2. 'Chromosome Techniques' by Sharma & Sharma

BT - 3108 BIO INSTRUMENTATION LABORATORY

Course Objectives:

* This lab has been designed to cover a variety of laboratory skills and techniques required to conduct laboratory sampling, testing and analysis in most Biotech industry sectors.

Course Outcomes:

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

* Develop the skill to understand the Bio-analytical Techniques.

* Judge to select analytical techniques for case study.

* Able to handle various equipments in the field of analysis.

* Professionally able to work independently in the industries and can carry out consultancy works.

* Summarize the process, interpret and report data.

List of Experiments:

1. Sample analysis by HPLC.

2. Amplification of bacterial DNA by PCR.

3. Characterization of microroganisms.

4. Separation of components in a mixture using Chromatography.

5. Quantification of biological macromolecules by UV Visible Spectrophotometer.

6. Identification of microorganism in the coliform group using IMViC test.

7. Separation of antigens and antibodies using Immune electrophoresis.

8. Determination of antibodies in the infected blood using ELISA technique.

BT-3109 SUMMER INTERNSHIP PROGRAM (Evaluation)

Evaluation of Summer Internship / Community Service in the industries / nearby villages which was carried out after 2nd year 2 semester during summer vacation.

BT-3201 GENETIC ENGINEERING

Course Objectives:

* The objective of this course is to discipline to students knowledge of main engines of implementation and transmission of a genetic material at molecular and cellular levels, and also methods of change of a genetic material and construction of transgene organisms with the given properties.

* Genetic engineering: refers to the process of manipulating the characteristics and functions of the original genes of an organism. The objective of this process is to introduce new physiological and physical features or characteristics.

* A gene is a basic constituent unit of any organism. It is a locatable region of a genome which contains the whole hereditary information of the organism. A gene corresponds to a unit of inheritance. It is a segment of the DNA which determines the special features or functions of the organism.

* Genetic engineering meddles with the organism's natural reproductive process, whether sexual or asexual. It gives it a new direction which is different from its natural disposition and development. The process involves the isolation and manipulation of the genes by introducing the new DNA into the cells. DNA is a blue print of the individual characteristics of an organism. The information stored in the DNA controls the management of biochemical process of each organism. The life, development and unique characteristics of the organism depend upon on its own DNA.

Course Outcomes:

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

* Apply genetic engineering for the benefit of mankind

* Explain the purification and manipulation of DNA

* Describe cloning vectors and libraries

* Understand PCR, Blotting and Fingerprinting techniques

* Indicate gene transfer methods and mutagenesis

* The domain of genetic engineering can extend from plants to cover both the animal and human life. It can, for example, hybridize the production of the animals and promote the growth of healthy species of milk producing animals, stronger and healthier horses, cows and bullocks which can better withstand the wear and tear of life.

SYLLABUS

Introduction, Purification and manipulation of DNA: History and scope of gene manipulation, isolation and purification of total cell DNA and plasmid DNA, DNA manipulative enzymes, restriction endonucleases- types, nomenclature, recognition sequence, cleavage pattern, restriction digestion and its analysis, Ligases – mode of action, strategies of ligation, linkers, adaptors and homopolymer tailing, DNA modifying enzymes,

Cloning Vectors and Libraries: E. coli vectors – construction and features of plasmids – p^{BR322}, p^{UC8}, p^{UC18}, p^{GEM3Z}, bacteriophage vectors – Lambda phage & M-13 phage vectors, cosmids, phasmids, shuttle vectors, yeast vectors - 2µm plasmid, yeast episomal plasmid and YACs, transfer and cloning of recombinant vectors, construction of genomic DNA libraries, cDNA libraries and their screening, gene cloning strategies,

PCR, Blotting and Fingerprinting techniques: Preparation of labeled probes and primers, DNA sequencing methods – Maxam & Gilbert method, Sangers and Automated sequencing method, PCR and its applications, southern blotting, northern blotting, DNA finger printing technique- RFLP and RAPD and its applications,

Gene transfer methods and mutagenesis: Gene transfer techniques – transformation, transfection, electroporation, lipofection and gene gun methods, cause of the mutagenesis, site specific mutagenesis, transposon mutagenesis, gene knockout technologies,

Applications, achievements and limitations: Application of genetic engineering in agriculture, animal husbandry, medicine, environmental management and in industry, achievements, limitations and negative aspects of geneic engineering.

Text Books:

1. “Gene cloning and DNA analysis” – An Introduction, T. A. Brown, Blackwell Publishing, 2006.

2. “Biotechnology” – B.D.Singh, kalyani Publishers, New Delhi, 2006.

Reference Books:

1. “Principles of Gene Manipulation and Genomics”, S. B. Primrose and R. M. Twyman, Blackwell Publishing, 2006.

2. “From Genes to Clones- Introduction to Gene Technology”, Winnacker, Panima Publishing Corporation, New Delhi.

BT-3202 BIOINFORMATICS

Course Objectives:

* The course essentially focuses on the development of skills of students for a successful career in industry or research. The course emphasizes on the delivery of the state of the art technologies in Genomics, Proteomics and Drug discovery.

Course Outcomes:

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

* Identify the major bioinformatics resources available so far

* Understand sequencing alignments and its data bases

* Explain taxonomy and phylogenetics neural networks leading to the role idea of the DNA in computer applications.

* Describe Genome mapping and its applications

SYLLABUS

Major Bioinformatics Resources: Knowledge of the following databases with respect to: organization of data, retrieval of data using text-based search tools, sources of data method for deposition of data to databases.Introduction, Primary & Secondary databse, Nucleic acid sequence databases: GenBank, EMBL, DDBJ Protein sequence databases: SWISS-PROT, TrEMBL, PIR_PSD Genome Databases at NCBI, EBI, ExPASy, TIGR, SANGER Prosite, PRODOM, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI Sequence and Structure Databases: PDB, MMDB Metabolic pathways databases such as KEGG, EMP.

Sequence Alignment and Database Searching: Introduction- Collection, annotation and alignment of sequences. Basic concepts of sequence similarity, identity and homology. Scoring matrices – PAM and BLOSUM, gap penalties, Database similarity searching, FASTA, BLAST.

Pairwise sequence alignments: Basic concepts of sequence alignment, Dynamic programming- Needleman &Wuncsh, Smith & Waterman algorithms for pairwise alignments

Multiple sequence alignments (MSA): the need for MSA, basic concepts of MSA (e,g. progressive, hierarchical etc.). Algorithm of CLUSTALW. Use of HMM method, concept of dendograms and its interpretation.

Taxonomy and phylogenetic analysis: Basic concepts in taxonomy and phylogeny; molecular evolution; nature of data used, Definition and description of phylogenetic trees and various types of trees, tree building and tree evaluation methods, Phylogenetic analysis algorithms such as Maximum Parsimony, UPGMA, Neighbor-Joining; Maximum likelihood algorithm.

Secondary structure prediction methods- ChouFASMAN/GOR, Nearest neighbor, Neural network

Genome Mapping and Applications: Human genome project, application of genome mapping, DNA microarrays.

Text Books:

1. Introduction to Bioinformatics. T.K. Attwood and P.J.Parry – Smith. Pearson Bioinformatics.

2. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

Reference Books:

1. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

2. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.

3. Bioinformatics Basics. Applications in Biological Science and Medicine by Hooman

H. Rashidi and Lukas K.Buehler CAC Press 2000.

4. Algorithms on Strings Trees and Sequences Dan Gusfiled. Cambridge University Press.

BT-3203 BIOCHEMICAL REACTION ENGINEERING

Course Objectives:

* To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.

* To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.

* To know the configuration of various bioreactors for cell growth and their operations.

* To understand the instrumentation and control of bioreactors and scale up aspects.

Course Outcomes:

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

* Understand the importance of bioprocess aspects and the role of bioprocess engineer.

* Analyze the enzyme kinetics and mechanism of their action.

* Design of various bioreactors.

* Explain the instrumentation used in bioreactors and their control.

SYLLABUS

Introduction to biotechnology and biochemical engineering, role of bioprocess engineer, regulatory constraints in bioprocesses, FDA, GMP, GLP and SOPs.

Fundamentals of biochemical reaction engineering:Kinetics of homogeneous reactions,elementary and non elementary reactions, reaction mechanism, temperature dependency from Arrhenius law.

Analysis of batch reactor data: Various methods of analysis of batch reactor data obtained for various types of reactions (excluding variable volume and variable pressure reactions).

Enzyme kinetics: Mechanism of enzyme action, Michaelis-Menten equation and determination of kinetic parameters, effect of pH and temperature.

Stoichiometry of microbial growth and product formation: Elemental balances, degree of reduction, yield co-efficients, maintenance co-efficients.

Cell kinetics and fermentor design: Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of kinetic parameters, Fed batch operation, chemostat with cell recycle, multistage chemostat systems.

Non-conventional bioreactors Air lift reactor, Bubble column reactor, Trickle bed reactor, scale up of bioreactors, bioreactor instrumentation and control.

Principles and mechanism of media and air sterilization: Batch and continuous sterilization of media, air sterilization, air filter design (thickness).

Text Books:

1. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi, 2002.

2. Biochemical Engineering fundamentals, 2nd Edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986.

Reference Books:

1. Textbook of biochemical engineering, D.G. Rao, Tata McGraw Hill, New Delhi,2004.

2. Biochemical Engineering, J. M. Lee, Prantice Hall 1992.

BT-3206 PROCESS CONTROL LABORATORY

Course Objectives:

* To understand the dynamic behaviour of the systems

* To evaluate response of fist and higher order characteristics.

* To calibrate the given thermocouple and resistance thermometer.

Course Outcomes:

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

* Identify the dynamics of first order, second order, interacting and non-interacting processes

* Explain the calibration of thermocouple

List of Experiments:

1. Response of Bare Thermometer for a step input
2. Response of Thermometer with thermal well for step input
3. Response of single tank for a step input
4. Response of Non – Interacting system for a step change
5. Response of a Interacting system for a step change
6. Response of resistance thermometer
7. Calibration of thermocouple
8. Response of manometer

BT-3207 BIOCHEMICAL REACTION ENGINEERING LABORATORY

Course Objectives:

* To evaluate the reaction rate constant and to determine the conversion in the Batch and Continuous reactors

Course Outcomes:

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

* Explain the kinetics of enzyme catalyzed reaction in free and immobilized states.

* Develop microbial enzymes.

* Evaluate the variables affecting the production process.

* Design of optimal Batch and Continuous reactors

List of Experiments:

Bioprocess Engineering

1. Isolation and characterization of industrial cultures for use as biocatalysts in bioprocesses and Analysis of raw materials used in common industrial bioprocesses
2. Production Ethanol & Protease
3. Parameter optimization studies in bioprocesses eg.Ethylalcohol, aminoacid production etc.
4. Product purification in bioprocess studies. Eg. Enzyme production (amylase, proteaseetc).
5. Measurement of Volumetric Oxygen transfer coefficient
6. Cell immobilization protocols
7. Immobilized bioprocess with cells and enzymes
8. Filter efficiency of common air filters
9. Heat inactivation of microbial cells, thermal death rate

Reaction Engineering

1. Determination of order of reaction using a Batch Reactor
2. Determination of rate constant using a Batch Reactor
3. Determination of rate constant using a CSTR
4. Determination of rate constant using a PFR
5. Determination of rate constant using a CFR (CSTR to PFR)
6. Determination of rate constant using a CFR (PFR to CSTR)
7. RTD studies in a packed bed Reactor
8. RTD studies in a Plug flow reactor

BT-3208 BIOINFORMATICS LAB

Course Objectives:

* Develop the ability to design, implement and manipulate algorithms.

* Develop computer programs for Bioinformatics solutions to life science and bioengg problems.

* Apply programming concepts to various biological examples and real life applications.

Course Outcomes:

* Understand algorithmic principles - Familiarity

* Write programs for specific computational biology problems

* Analyze problems in biology and able to design algorithms for biological data analysis

* Analyze biological data through programs

* Implement algorithms for bioinformatics problems

List of Experiments:

1. Sequence retrieval from DNA & Protein databases.
2. Sequence alignment /Annotation-Dot Plot.
3. BLAST.

4. Multiple Sequence Alignment (CLUSTALW).
5. Phylogenetic Analysis.
6. Structure Visualization of Proteins.
7. Restriction Mapping.
8. Identification of Genes in Genomes.
9. Primer Design.
10. Molecular Docking

BT-3209 SOFT SKILLS

Course Objectives:

* To develop skills to communicate clearly.

* To aid students in building interpersonal skills.

* To enhance team building and time management skills.

* To inculcate active listening and responding skills.

Course Outcomes:

* Make use of techniques for self-awareness and self-development.

* Apply the conceptual understanding of communication into everyday practice.

* Understand the importance of teamwork and group discussions skills.

* Develop time management and stress management.

Learning Outcomes:

* Acquisition of etiquette and skills that an engineer requires.

* Students will develop the acumen for self-awareness and self-development.

* Students will be able to communicate unmistakably.

* Students will be able to tackle real-life challenges.

Unit-I : Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Unit-II : Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

Unit-III : Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

Unit-IV : Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analysing Performance.

Unit-V : Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, Close-Ask Q), Telephone Interviews, Types of Questions.

Reference Books:

1. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for Creating Dynamite Resumes. United States, Impact Publications, 2005.

2. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012.

3. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Education, 2001.

4. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

5. Rizvi, Ashraf M. Effective Technical Communication: India, McGraw-Hill Education. 2010.

6. Thorpe, Edgar & Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.

BT-4106 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

* To familiarise the students with the concepts of Management.

* To relate the concepts of Management with Industrial Organisations.

* To explain the factors affecting productivity and how productivity can be increased with effective utilization of inputs in an industrial undertaking.

* To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

* An engineer with his/her fundamental knowledge of Industrial Management, will be in position to take appropriate decisions in the corporate environment. The concepts of Entrepreneurship acts as a motivating factor to launch new enterprises and translate one's dream into realty.

SYLLABUS

Basic Concepts of Management:

Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations:Introduction, Types of Business organizations: Private Sector- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental

Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance

Entrepreneurship: Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

1. Sharma,S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.

2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management(Planning for future Sustainable growth), HImalayan Publishing House, 2018.

Reference Books:

1. Aryasri , A.R., Management Science, McGraw HIll Education (India Private Limited , New Delhi 2014.

2. Sheela, P. , and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

BT-4107 BIOSTATISTICS

Course Objectives:

* To make them understand about the Introduction of bioinformatics, Moments like skewness and kurtosis, correlation, Probability distribution and sampling theory, Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling and Numerical solutions of PDEs.

Course Outcomes:

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

* Classify data and understand relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion.

* Understand coefficient of correlation both for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

* Solve PDE's numerically

* Explain probability distribution and sampling theory

SYLLABUS

Introduction, collection and classification of data, graphical representation, histogram, frequency polygon and cumulative frequency curve, comparison of frequency distributions, measures of central tendency, mean, median and mode, an empirical relation between mean, median and mode, geometric mean and harmonic mean, measures of dispersion – range, quartile deviation or semi-inter quartile range, mean deviation, root mean square deviation, standard deviation, variance, coefficient of variation, empirical relation between measures of dispersion, standard deviation of combined samples.

Moments, skewness and kurtosis, correlation, scatter diagram, coefficient of correlationboth for ungrouped and grouped data, lines of regression, standard error of estimate, rank correlation.

Probability distribution and sampling theory: Random variable both discrete andcontinuous, probability distribution both discrete and continuous, cumulative distribution, expectation, variance, standard deviation, moment generating function, binomial distribution, constants of binomial distribution, mean, standard deviation, skewness and kurtosis, fitness of a binomial distribution, Poisson distribution, constant of poisson distribution, mean, standard deviation, skewness and kurtosis – fitting of a poisson distribution, normal distribution, standard normal distribution, propertive normal distribution, probability error, fitting of normal distribution.

Sampling Theory: sampling, random sampling, parameters and statistic, objectives of sampling, sampling distribution, standard error, testing of hypothesis, errors, null hypothesis, level of significance, testing significance, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples, test of significance for means of two large samples, sampling of variables, small samples, number of degrees of student t-distribution, significance test of difference between sample means, f- distribution, Fisher's z-distribution, Chi-square distribution.

Numerical solutions of PDEs – Elliptic (Liebmann iteration process), Parabolic (Schmidt explicit formula), Hyperbolic and Poisson's equations (Gauss – siedel method).

Text Book:

Higher engineering mathematics by B.S.Grewal

References Books:

1. Numerical methods for Scientific and Engineering Computation by M.K.Jain, S.R.K.Iyengar, R.K.Jain, and Publishers New age international (P) Ltd. New Delhi

2. Probability, Statistics and random process by T. Veerarajan, Tata McGraw Hill.

3. Probability, Statistics with Reliability, Queing and Computer Science Application by Kishore S. Trivedi

BT - 4108 INDUSTRIAL / RESEARCH INTERNSHIP EVALUATION

Evaluation of Summer Internship in the industries / Research Institutions which was carried out after 3rd year 2 semester during summer vacation.

BT-4201 PROJECT WORK

(Project Work/ Internship shall be carried out in the Industry)

Course Outcomes:

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

* Carry out literature review

* Formulate the problem involving manufacture of a chemical product/ experimentation/modeling/simulation/optimization/design

* Carry out the project involving manufacture of a chemical product/ experimentation/ modeling/simulation/optimization/design/industrial problem

* Discuss the results

* Communicate results orally to audience

* Present the detailed written report

PROFESSIONAL ELECTIVES

1. PROCESS CONTROL

Course Objectives:

In this course, the students will learn

* To represent the processes in terms of mathematical equations

* The concept of stability and know how to operate a control system in a stable way.

* To deal with various controllers and their functions and applications.

Course Outcomes:

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

* Develop transfer functions for the processes

* Examine the stability of various control systems

* Apply advanced control schemes for processes and identify the characteristics of control valves

SYLLABUS

Introduction to process dynamics and control, Response of First Order Systems - Physical examples of first order systems. Response of first order systems in series, higher order systems: Second order and transportation lag.

Control systems Controllers and final control elements, Block diagram of a chemical rector control system. Closed loop transfer functions, Transient response of simple control systems.

Stability Criterion, Routh Test, Root locus. Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.

Advanced control strategies, Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control. Controller tuning and process identification. Control valves.

Text Book:

D.R. Coughanowr. Process Systems Analysis and Control, Mc Graw Hill, 1991

Reference Book:

Chemical Process Control, G. Stephanopolous, Prentice Hall, 1984.

2. AGRICULTURAL BIOTECHNOLOGY

Course Objectives:

* To make the student learn about the biotechnological approach in the field of agriculture.

* To make the student understand structure and functioning of genes and gene manipulation in plants so as to enhance the quality and crop production.

* To make them to acquaint the novel techniques in the improvement of Agriculture.

Course outcomes:

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

* Understand molecular biology, biochemical concepts for the production and improvement of agricultural practices.

* Develop the theoretical approach to study and understand the importance of genetic approach in the field of agriculture.

SYLLABUS

Introduction - Definition, classical vs modern approach, demand for biological resources, achievements, Nitrogen Fixation-Basic concepts, nif genes and their regulation, potential scope in crop improvement,

Genetic engineering- aims of genetic engineering, techniques of gene manipulation, Transformation Techniques -Physical methods, Agrobacterium, mediated transformation.

Transgenics -Basic concept and essential steps of the process, some examples of transgenic plants, use of suitable promoters, gene silencing and measures to overcome it, commercial aspects of the technology.

Molecular Markers - concept, SNPs, RAPD, RFLP, role in crop improvement and genome mapping, Molecular and biochemical basis, signalling pathways in the production of transgenic plants for fungal, bacterial and viral disease resistance; herbicide resistance, pest resistance, drought and other abiotic stress resistance, Plant as Biofactories- Concept, production of chemicals, pigments, perfume, flavors, insecticides, anticancer agents and other important compounds, molecular farming, use of plants for production of neutraceuticals, edible vaccines and other desired products, SCP - micro organisms, nutritional value, production of algal biornass, bio fertilizers and bio pesticides, mass cultivation of Rhizobium, Azatobacter, Azospirillum, Mycorrhiza, bluegreen algae and Azolla.

Text Books:

1. "Agricultural Biotechnology" by Arie Altman, Marcel Dekker, Inc. (2001)
2. "Agricultural Biotechnology", by S.S.Purohit, Agro Bios (India)

Reference Book:

"Molecular Biotechnology Principles and Applications of Recombinant DNA", by Bernard R. Glick and Jack J. Pasternak,. ASM Press

3. ENGINEERING ECONOMICS & BIOPROCESS DESIGN

Course Objectives:

* To introduce bioprocess design with its basic function of a bioreactor.

* To study the construction of bioreactor.

* To introduce the basic fundamentals such as aeration and agitation used in fermentation industrial.

* Designing of fermentation vessels and problems related to scale up of microbial processes.

* Engineering economics deals with value of money equivalence and depreciation.

Course Outcomes:

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

* Understand fundamentals concepts of bioprocessing

* Design and operate a Bioprocess/fermentation vessels..

* Understand the value of money equivalence and depreciation.

SYLLABUS

Engineering Economics: Value of money equivalence: Value of money, equations for economic studies, equivalence, types of interest, discrete, continuous, annuities: relation between ordinary annuity and the periodic payments, continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalised costs, bonds and debentures: value of a bond and yield rate,

Depreciation: Types and various methods of calculating depreciations, depreciation accounting, cost accounting- basic relationship in accounting, balance sheet and income statements.

Bioprocess Design: Basic function of a Bioreactor for plant and microbial or animal cell culture, factors involved in bioreactor design and principal operating characteristics of bioreactors. Body construction: construction material, temperature control,

Aeration and agitation: Agitators (impellers), stirrer glads and bearings, baffles, aeration system (spargers), valves and steam traps used in fermentation industries,

Scale up: Basic concepts, problems related to the scale up of the microbial processes, designing of other fermentation vessels,

Text Books:

1. 'Plant Design and Economics for Chemical Engineers' fourth edition, by Max S Peters and Klans D Timmerhans, Mc Graw Hill Book Company
2. 'Fermentation and Biochemical Engineering Handbook' 2nd Edition by Henry C. Vogel and Celeste L. Todaro, Noyes Publications, 1997.

Reference Books:

1. 'Biochemical Engineering Fundamentals', 2nd edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986
2. 'Bioprocess Engineering' 2nd edition, M.L.Shuler and F.Kargi, Prantice Hall India, New Delhi
3. 'Principles of Fermentation Technology' by Stanbury, Pergamon
4. 'Text Book of Biochemical Engineering', by D.G. Rao, Tata McGraw Hill

4. INDUSTRIAL BIOTECH PRODUCTS

Course Objectives:

* To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.

* To study about the preparation of alcohol using yeast cells and sugars by fermentation process.

* To study about the production of Acetic acid, Citric acid and lactic acid using fermentation technology.

* To study about the production of fungal foods- mushroom and other foods like cheese. And also studies the production of bakers yeast, amino acids and vitamins(Microbial origin)

* To study about the antibiotics production, industrial enzymes-amylase, protease, lipase, and the production of biopolymers- Xanthan gum.

Course Outcomes:

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

* Explain the preparation of microbial slants, maintenance of stock cultures and other microbial techniques

* Describe the production of alcohols using fermentation technology.

* Demonstrate the production of acetic acid, citric acid, lactic acid using micro organisms and biological substrates by fermentation technology.

* Explain the production of foods using microorganisms and the production of mushrooms, cheese and vitamins, etc.

* Demonstrate the production of antibiotics and enzymes used in large scale and production of vaccines and biopolymers

SYLLABUS

Microbial Processes: Introduction, types of fermentations, components of industrial microbial process, source of industrial cultures, maintenance and improvement of culture for better production,

Alcohol fermentation: Production of industrial alcohol, biosysthetic mechanism, recovery of latest developments, wine manufacture, glycerol fermentation, production of acetone and butanol,

Organic acid production- Biochemistry of acetic acid production, vinegar manufacture, production of citric acid and lactic acid,

Microbial foods: Mushrooms, cheese, Baker's yeast Amino acids – L-Glutamic acid, Lysine

Vitamins – Vitamin B12

Antibiotics – Penicilin and streptomycin.

Industrial enzymes: production of amylase, protease and lipase Miscellaneous-Biopolymers (Xanthan gum, dextran etc), vaccines.

Text Books:

1. "Industrial Microbiology" by Cruger&cruger
2. "Industrial Microbiology" by Cassida
3. "Industrial Microbiology" by A.H.Patel

Reference Books:

1. 'Industrial Microbiology' by Prescott & Dunn
2. "Biotechnology" by U. Satyanarayana.

5. PHARMACEUTICAL BIOTECHNOLOGY

Course Objectives:

* The main objective of this course is to contribute to improve human health by exploiting the potential biopharmaceutical research by

* Promoting research and development in the field of pharmaceutical biotechnology.

* Promoting interactions between academia, biotechnology and pharma companies within the field of pharmaceutical biotechnology to support creativity, innovations and facilitate the commercialization of scientific finding.

Course Outcomes:

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

* Understand application of therapeutic agents and regulatory aspects

* Explain drug metabolism and pharmacokinetics

* Describe important unit processes and their application sin bulk drug manufacturing, tablets and capsules manufacturing

* Summarize the manufacturing principles and quality management

* Categorize pharmaceutical products and indicate their control

SYLLABUS

Introduction- Development of Drug and Pharmaceutical Industry, Therapeutic agents – their uses and economics, Regulatory aspects. Drug metabolism and Pharmacokinetics- Metabolism, Physico- chemical principles, radioactivity, Pharmaco kinetics action of drugs on human bodies.

Important Unit Processes and their applications: Bulk drug manufacturing, Types of reactions in bulk drug manufacturing and processes, Special requirements for Bulk Drug manufacture.

Manufacturing Principles: Wet granulation, Dry granulation or slugging, Direct compression, Tablet presses. Coating of tablets, capsules. Sustained action dosage. Forms- Parental solutions, oral liquids, injections, ointments. Various topical drugs and pharmaceuticals, Packaging- Packaging techniques, Quality management and GMP.

Pharmaceutical products and their control- Therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals- Hormones.

Text Books:

1. Leon and Lachman et al- Theory and Practice of Industrial pharmacy.
2. Cooper and Gunn's – Dispencing Pharmacy.

Reference Book:

Remington's Pharmaceutical Sciences, Mark publishing and Co.

6. ANIMAL CELL CULTURE AND HYBRIDOMA TECHNOLOGY

Course Objectives:

* The main objective of this course is to contribute for the improvement of human health by exploiting the potential biotechnological research by promoting research and advanced development in the field of biotechnology.

Course Outcomes:

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

* Understand the laboratory design and equipmentsfor cell culture

* Identify the media and reagents for cell culture,purification and preservation

* Differentiate the types of cell culture

* Describe the scale up of the cell culture reactors

* Apply animal cell culture in pharmaceutics, production of vaccines, growth hormones and interferons

* Apply monoclonal antibodies in various fields.

SYLLABUS

Cell culture: Laboratory design and equipments planning, construction and services and equipment, cryopreservation equipment and principle, water purification system, washing, packing and sterilization of different materials used in animal cell culture, asceptic concepts, maintenance of sterility in cell culture vessels,

Media and Reagents: Types of cell culture media, ingredients of media; physiochemical properties, CO2 and bicarbonates, buffering, oxygen, osmolarity, temperature, surface tension and foaming, balance salt solutions, antibiotics and growth supplements, foetal bovine serum, serum free media, selection of medium and serum, conditioned media, other cell culture reagents, preparation and sterilization of cell culture media, serum and other reagents.

Different types of cell cultures: Primary culture and its preparation, establishment of primary culture, subculture –passage number, split ratio, seeding efficiency and criteria for subculture, continuous cell lines, suspension culture, behavior of cells in culture conditions: division, growth pattern, estimation of cell number, development of cell lines, characterization and maintenance of cell lines, common cell culture contaminants, cell transformation, normal Vs transformed cell and agents that cause transformation.

Scale-up: Cell culture reactors, scale-up in suspension, scale and complexity, mixing and aeration, rotating chambers, perfused suspension cultures, fluidized bed reactors for suspension culture, scale-up in monolayers, multisurface propagators, multiarray disks, spirals and tubes, roller culture, microcarriers, perfused monolayer cultures, membrane perfusion, hollow fiber perfusion, matrix perfusion, microencapsulation, growth monitoring,

Applications: Cell cloning and selection, transfection and transformation of cells, commercial scale production of animal cells, stem cells and their application, application of animal cell culture in pharmaceutics, production of vaccines, growth hormones and interferons, hybridoma technology, production of hybridoma, screening and applications of monoclonal antibodies in various fields.

Text Books:

1. "Culture of Animal Cells", (3rd Edition) by F1. Ian Freshney, Wiley-Liss,
2. "Animal Biotechnology" by M.M.Ranga, 2002 Edition.

7. CANCER BIOLOGY

Course Objectives:

* To understand basic nature as well as advanced aspects of cancer. The cause & regulation of cancer cell cycle, Molecular approach of cancer study, Detection and prediction studies of cancer cell growth.

Course Outcomes:

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

* Understand fundamentals of cancer biologyand cancer metastasis

* Explain the causes of cancer and cancer detection

* Identify oncogenes and rectoviruses

* Differentiate cancer therapies,their advantages and limitations

SYLLABUS

Fundamentals of Cancer Biology: Introduction, regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, classification of cancer, modulation of cell cycle in cancer. Carcinogenesis, cancer initiation, promotion and progression,

Causes for Carcinogenesis: Chemical carcinogenesis, metabolism of carcinogenesis, natural history of carcinogenesis, targets of chemical carcinogenesis, principles of physical carcinogenesis, X - ray radiation, mechanism of radiation carcinogenesis,

Molecular Cell Biology of Cancer: Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, growth factor and growth factor receptors that are oncogenes, oncogenes / proto oncogene activity, growth factors related to transformations, tumor suppression, tumor suppressor genes,

Principles of Cancer Metastasis: Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three-step theory of invasion, proteinases and tumor cell invasion,

Detection of Cancer; Detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection, different forms of therapy, chemotherapy, radiation therapy and immuno therapy, advantages and limitations.

Text Books:

1. "Cancer Biology" by Raymond W. Ruddon, Oxford University Press Inc., 2007 Ed., NY.

2. "The Basic Science of Oncology" by Ian F.Tannock et al, 4th edition, 2007. Mc Graw Hill Company.

8. STEM CELLS IN HEALTH CARE

Course Objectives:

* Aim of this course is to know the nature of embryonic cells which develop into specific tissues and organs.

Course outcomes:

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

* Understand the stem cell basics

* Classify stem cells and identify their applications

* Apply stem cell in drug delivery and tissue engineering

* Apply stem cells in therapeutic applications in Parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries,Alzheimer's diseaseetc

* Describe the applications of stem cells in tissue engineering application and production of complete organs – kidney, eyes, heart, brain

SYLLABUS

Stem cell basics: Unique properties of stem cells, embryonic stem cells, adult stem cells, umbilical cord stem cells, similarities and differences between embryonic and adult stem cells, properties of stem cells – pluripotency, totipotency, multipotency.

Embryonic stemcells: Invitro fertilization, human embryonic stem cells, blastocyst, inner cellmass, growing ES cells in laboratory, laboratory tests to identify ES cells, stimulating ES cells for differentiation, properties of ES cells, human ES cells, monkey and mouse ES cells.

Adult stem cells: Somatic stem cells, test for identification of adult stem cells, adult stem cell differentiation, trans-differentiation, plasticity, different types of adult stem cells.

Stem cell in drug discovery and tissue engineering: Target identification, manipulating differentiation pathways, stem cell therapy Vs cell protection, stem cell in cellular assays for screening, stem cell based drug discovery platforms, drug screening and toxicology.

Genetic engineering and therapeutic application of stem cells: Gene therapy, genetically engineered stem cells and animal cloning (transgenic animals), biomarkers in cancer, therapeutic applications in parkinson's disease, neurological disorder, limb amputation, heart disease, spinal cord injuries, diabetes, matching the stem cell with transplant recipient, HLA typing, Alzheimers disease, spinal cord injuries, tissue engineering application, production of complete organs – kidney, eyes, heart, brain.

Text Books:

1. "Stem Cells, Human Embryos and Ethics: Interdisciplinary Perspectives" by Larstnor, Springer, 2008

2. 'Handbook of Stem Cells', Volume-1, by Robert Paul Lanza, Gulf Professional Publishing, 2004

Reference Books:

1. "Embryonic Stem cells"byKursad and Turksen. 2002, Humana Press.

2. "Stem Cell and Future of Regenerative medicine by Committee on the Biological and Biomedical Applications of Stem cell Research", 2002, National Academic Press.

9. FOOD TECHNOLOGY

Course Objectives:

* To identify Pathogenic and spoilage microorganisms in foods, the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods, laboratory techniques to identify microorganisms in foods, beneficial microorganisms in food systems ,understand the principles involving food preservation via fermentation processes, influence of the food system on the growth and survival of microorganisms, understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., pH, temperature) on growth and response of microorganisms in various environments, Understand the principles involving food preservation via fermentation processes.

Course Outcomes:

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

* Identify the good manufacturing conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

* Understand the elements of food processing and preservation

* Explain the techniques of food processingoperations.

SYLLABUS

Food processing and preservation: Biotechnology in relation to the food industry, nutritive value of the food, types of microorganisms associated with the food, food colors and flavors, enzymes and chemicals used in food processing, food preservation.

Fermented food products: Microbial culture used in food industry, fermentation technology for food industry & waste utilization. Bioprocessing and fermentation of meat, vegetables, fruits, dairy products, non-beverage plant products, beverages and related products of baking.

Food spoilage and Food Microbiology: Food spoilage, food borne illness, food quality and quality control, HFCS (High Fructose Corn Syrup), single cell protein production.

Food processing operations: Food engineering operations: characteristics, cleaning, sorting and grading of food raw materials, food conversion operations, size reduction, mixing, emulsification, filtration, membrane separation, centrifugation, extraction, and crystallization, microwave heating, thermal inactivation of microorganisms, freezing and thawing of foods.

Text Books:

1. "Biotechnology: Food fermentation", by V.K. Joshi & Ashok pandey.
2. "Food processing and preservation", by B. Sivasankar

Reference Books:

1. "Food Biotechnology", by Roger Angold, Gordon Beech & Taggart 2. "Basic Food Microbiology", by George J Banward, CBS publishers
2. "Modern Food Microbiology", by James M Jay, CBS publishers.

10. PROCESS OPTIMIZATION

Course Objectives:

* Optimization of Chemical Process is an important of subject for Chemical Engineers. It deals with various optimization techniques in reducing cost of production ,energy consumption, maximum throughput and minimum labour cost etc. Onstudying the course one can understand how to write a model of the process optimize the process using the model

Course Outcomes:

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

* Understand the definition of Optimization and how to write an Objective function

* Understand various types of Objective functions like Concave and Convex functions and its properties

* Study the Optimization of uni- &multi dimensional search problems

* Solve the Optimization problems by Linear and Non-Linear Programming methods

SYLLABUS

Basic Concepts of Optimization: Introduction to process optimization; continuity of functions, unimodal versus multimodal functions, convex and concave functions, convex region, necessary and sufficient conditions for an extremum of unconstrained function, interpretation of the objective function in terms of its quadratic approximation,

Optimization of unconstrained Functions - One-dimensional Search: Numerical methods for optimizing a function of one variable, scanning and bracketing procedures; Newton, quasi- Newton and secant methods of uni-dimensional search, Newton's method, quasi-Newton method, secant method,

Region Elimination Methods, polynomial approximation methods - quadratic interpolation, cubic interpolation, how the one-dimensional search is applied in a multidimensional problem, evaluation of uni-dimensional search methods,

Unconstrained Multivariable Optimization: Direct methods- random search, grid search, uni-variate search, simplex method, conjugate search directions, Powell's method, indirect methods first order - gradient method and conjugate gradient method, indirect method second order – Newton's method,

Linear Programming and its Applications: Basic concepts in linear programming, degenerate LP's – graphical solution, natural occurrence of linear constraints; the Simplex method of solving linear programming problems,

Nonlinear Programming with Constraints: Lagrange multiplier method, necessary and sufficient conditions for a local minimum, generalized reduced-gradient method, random search methods, and comparative evaluation of different methods,

Global Optimization: Overview of genetic algorithm, simulated annealing and other global optimization methods, heuristic search methods.

Text Book:

"Optimization of Chemical Processes", 2nd Edition, by T.F.Edgar, D.M.Himmelblau and L.S.Lasdon McGraw-Hill, 2001.

Reference Books:

1. "Applied Optimization with MATLAB" by .P.Venkataraman, John Wiley
2. 'Optimization for Engineering Design' by K.Deb, Prentice Hall of India Private Limited, New Delhi, 2003
3. 'Engineering Optimization', 3rd Edition, by S.S. RaoWiley, 1996.

11.ENERGY ENGINEERING

Course Objectives:

* To lean overview of energy sources.
* To know the production of various fuels from petroleum.
* To learn various nonconventional energy sources like solar energy, bio-energy, wind energy, water energy etc.
* To learn storage of energy.

Course Outcomes:

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

* Classify energy sources
* Demonstrate the production of fuels from petroleum
* Discussthe principles and practice of Photo voltaic cells
* Describe biogas generation
* Explain storage of energy

SYLLABUS

Conventional energy sources: The present and scope for future development, _ utilization of coal, formation, analysis, classification, storage and carbonization, byproduct recovery

Petroleum: Origin, classification, single and multi-stage fractionation, reforming, catalytic cracking, specification of kerosene, motor gasoline and fuel oils, liquified petroleum gas and nature gas, composition, properties and uses

Non-conventional energy sources: Solar radiation, principles of heating, cooling and photo- voltaic cells

Biogas production: Biomass, wind energy, tidal and wave energy, geothermal energy, nuclear energy, ocean thermal energy, hydrogen energy

Fuel cells: Storage of energy, types - water storage, packed bed storage, solar storage, chemical storage, phase change storage, mechanical energy storage and windmill storage

Text Books:

1. "Fuels and Combustion", by S. Sirkar, Orient Longmans, 2nd Ed.
2. "Solar Energy, Thermal Storage", by S.P. Sukhatme, TMH
3. "Non-conventional Energy Sources", by G. D. Rai, Khanna Publications.

12. SYSTEMS BIOLOGY

Course Objectives:

* The purpose of this course is to provide insight inot quantitative modeling of biological systems at the molecular and cellular level as well as, how they are used, analyzed and developed.

Course Outcomes:

The student will be able to

* Explain the principles of system biology and experimental techniques.
* Apply achieved methodological knowledge to biologically relevant problems.
* Interpret the results from commonly used systems biology methods.

SYLLABUS

Introduction: Basic principles of systems biology, experimental techniques,

Standard models and approaches: Metabolism- enzyme kinetics and thermodynamics, metabolic networks, metabolic control analysis,

Biological processes: Signal transduction- introduction, function and structures, interactions, structural components, signaling selected biological processes,

Evolution: Introduction, mathematical models, prediction of biological systems, data integration,

Applications: Systems biology in various fields, databases and tools, modeling tools.

Text Books:

1. "Systems Biology in Practice-Concepts, Implementation and Application" by Edda Klipp and Ralf Herwig, Wiley VCH, I Edition
2. "Systems Biology: Definitions and Perspectives" by Lilia Alberghina and Hans V. Westerhoff, Springer, 2005.

Reference Books:

1. "Systems Biology: Principles, Methods, and Concepts" by Andrzej K. Konopka, CRC Press, 2006
2. "Stochastic Modelling for Systems Biology" by Darren James Wilkinson, CRC Press, 2006.

13. ENVIRONMENTAL BIOTECHNOLOGY

Course Objectives:

* To make the student learn about origin and evolution of microbes.

* To make the student understand structure and functioning of different microbial groups

* To make them to acquaint the cultivation of microbes in artificial medium.

Course Outcomes:

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

* Understand environment and economy

* Differentiate the biological waste water treatment methods

* Describe the applications of biodegradation and bioremediation

* Discuss Biofertilizers and Biopesticides, Biopolymers, Bioplastics and Biofuels

* Explain Biosorption, Bioleaching, Biodiversity

SYLLABUS

Environment: Types and Components of Environment, Environmental Education, Ecology, Ecosystems, Ecological Pyramids, Food Chains, Food Web, Nutrient Cycling, Ecological Succession, Microbial Associations. History of Environmental Biotechnology.

Biological Waste Water Treatment: Biological Processes for Domestic and Industrial Waste Water Treatment. Trickling filters, Activated Sludge Process, Rotating Biological Contactors (RBC), Packed Bed Reactors (PBR), Anaerobic Digestion, Fixed Film Reactors, Up Flow Anaerobic Sludge Blanket Reactor(UASBR), Waste Water Cycling.

Biodegradation and Bioremediation: Introduction, Factors Effecting Bioremediation, Enzyme Systems for Bioremediation, Types of Bioremediation, Bioremediation of Contaminated Soils and Waste Lands, Phytoremediation, Degradation of Xenobiotic Compounds:Petroleum products, Alkanes, Aromatic Compounds. Biofertilisers and Biopesticides, Biopolymers and Bioplastics, Biosorption, Bioleaching Biofuels, Biodiversity.

Textbooks:

1. Environmental Biotechnology: Basic concepts and applications by Indu Sekhar Thakur I.K. International Pvt. Ltd. New Delhi.

2. Biotechnology by U. Satyanarayana, Books and Allied (P) Ltd. Koldata.

Reference Books:

1. Biotechnology and Biodegradation. Advances in applied biotechnology, Vol-4 by Karnely, D. Chakraborthy, Omen, G.S. Guld Publications co; LONDON.

2. Bioremediation Engineering: Designand Applications by John Cookson Jr; Mc GrawHill. INC.

14. BIOPROCESS ENGINEERING

Course Objectives:

* To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.

* To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.

* To know the configuration of various bioreactors for cell growth and their operations.

* To understand the instrumentation and control of bioreactors their scale up aspects etc.

Course Outcomes:

* The student is able to know the importance of bioprocess aspects and the role of bioprocess engineer.

* The student can analyze the kinetics and mechanism of enzyme action.

* The student will be able to design a bioreactor.

* The student will know about the instrumentation used in bioreactors and their operation.

SYLLABUS

Introduction to biotechnology and bioprocess engineering, role of bioprocess engineer, regulatory constraints in bioprocesses, FDA, GMP, GLP and SOPs.

Enzyme kinetics: Mechanism of enzyme action, Michaelis-Menten equation and determination of kinetic parameters, effect of pH and temperature.

Stoichiometry of microbial growth and product formation: Elemental balances, degree of reduction, yield co-efficients, maintenance co-efficients.

Cell kinetics and fermentor design: Batch growth cultivation, batch, continuous and plug flow fermentors, Monod growth kinetics in continuous culture and evaluation of kinetic parameters, Fed batch operation, chemostat with cell recycle, multistage chemostat systems.

Non-conventional bioreactors, Scale up of bioreactors, bioreactor instrumentation and control, bioreactors for animal culture.

Principles and mechanism of media and air sterilization: Batch and continuous sterilization of media, air sterilization, air filter design.

Text books:

1. Bioprocess Engineering 2nd edition, M. L. Shuler and F. Kargi, Prantice Hall India, New Delhi.

2. Biochemical Engineering fundamentals, 2nd Edition, E.Bailey and D.F.Ollis, McGraw Hill, 1986.

Reference Books:

1.Textbook of biochemical engineering, D.G. Rao, Tata McGraw Hill, New Delhi,2004.

2. Biochemical Engineering, J. M. Lee, Prantice Hall 1992.

15. PROCESS MODELING & SIMULATION

Course Objectives:

* To introduce different types of models along with examples related to chemical engineering

* To instruct how to develop empirical models using different tools and the use of numerical methods for solution of Non- Linear Algebraic equations

* To disseminate the use of different numerical techniques for carrying out numerical integration and differentiation.

* To impart knowledge on modelling of various equipment and their simulation using different numerical techniques.

* To guide selection of the solution method based on the computational requirements of various solution options.

* To elucidate process simulation using modular and equation based solving approaches.

Course Outcomes:

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

* Classify different types of mathematical models

* Develop mathematical model for the given chemical engineering problem from basic engineering principles.

* Identify the appropriate numerical method for solving a given model.

* Solve ODEs and PDEs using different numerical methods.

* Simulate binary distillation column, gravity flow tank, batch reactor, Non-isothermal CSTR, and counter-current heat exchanger.

* Compare and contrast modular approaches with equation oriented approach

SYLLABUS

Mathematical models for chemical engineering systems: classification of mathematical models- steady state vs dynamic models, lumped vs distributed parameter models, deterministic vs stochastic models. Examples of mathematical models- Two heated tanks, batch reactor, constant volume CSTRs, non-isothermal CSTR, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup. Empirical model building-method of least squares, linear, polynomial and multiple regression, non-Linear regression. Solution of Non- Linear Algebraic equations- bisection, false position, Quasi Newton and Newton- Raphson methods.

Numerical integration- Trapezoidal rule, Simpson's rule and Newton–Cotes formula.

Numerical solution of differential equations- Euler's method, Runge- Kutta methods, predictor corrector methods.

Numerical solution of partial differential equations- elliptic, parabolic and hyperbolic equations, finite difference methods, Leibman's method, Crank Nicholson method. Applications to steady state and Unsteady state heat conduction and temperature distribution problems.

Process Simulation examples: VLE dew point and bubble point calculations, binary distillation column, gravity flow tank, batch reactor, Non-isothermal CSTR, countercurrent heat exchanger.

Process simulation using modular and equation based solving approaches: Developing a simulation model, a simple flow sheet, Sequential modular approach, Simultaneous modular approach, Equation solving approach.

Textbooks:

1. Process modelling, Simulation and Control for Chemical Engineers, 2nd ed., W. L. Luyben, McGraw-Hill, New York, 1990.

2. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995.

Reference Books:

1. Numerical Methods for Engineers and Scientists, S.S. Rao

2. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010

3. Process Modelling and Simulation, Amiya K. Jana, 2012.

OPEN ELECTIVES

1. CORROSION ENGINEERING

Course Objectives:

* Basic aspects of electrochemistry relevant to corrosion phenomena,

* Importance and forms of corrosion.

* Knowledge on corrosion rate expressions and measurement techniques.

* Basic knowledge on remedial measures for corrosion.

Course Outcomes:

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

* Identify various forms of corrosion.

* Determine corrosion rates for metals from their polarization curves

* Analyze corrosion rate characteristics from electrochemical impedance spectroscopy

* Select suitable corrosion resistant coatings, oxide layers for various applications

SYLLABUS

Introduction and Scope: Corrosion definition, wet and dry corrosion, mechanism, electro-chemical principles and aspects of corrosion, Faradays laws, resistance, specific resistance, conductance, specific conductance, transport numbers, ionic mobility, corrosion rate expressions, calculation of corrosion rates, thermodynamic aspects of corrosion, equilibrium potential, Nernst equation for electrode potential, EMF series, over voltage, application of Nernst equation to corrosion reactions,

Polarisation and Corrosion Potentials: References electrodes for corrosion measurements, types of polarisation, concentration, activation and resistance polarizations, Tafel constant, Evans diagrams, anodic control, cathodic control, mixed control, Pourbaix-diagram for Fe-H_2O system,

Various forms of Corrosion: Uniform attack, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching (dezincification), cavitation damage, fretting corrosion, erosion corrosion, and stress corrosion and remedial measures,

Prevention Techniques: Modification of the material by alloying, appropriate heat treatment, chemical and mechanical methods of surface treatment, metallic, non-metallic linings, inhibitors, passivity, Cathodic protection and anodic protection.

Text Books:

1. 'Corrosion Engineering' by Mars G. Fontana, Tata McGraw Hill Publishing Company, New Delhi

2. 'Corosion and Corrosion Control' by H.H.Uhllg, John Wiley & Sons Inc., America

Reference Books:

1. 'Electrochemistry' by Samuel Glasstone, Litton Educational Publishing Company

2. 'Electrochemistry, Principles & Applications' by Edmond C.Potter, Cleaver Hume Press Limited.

2. WHITEWARE AND HEAVY CLAYWARE

Course Objectives:

* The applications for advanced ceramics have received major attention in recent years, particularly for use as parts in a future ceramic heat engine.

* The properties like corrosion resistance, chemical inertness, thermal shock resistance and other properties made both traditional and advanced ceramics highly attractive in a large number of applications.

Course Outcomes:

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

* Classify whiteware products

* Identify raw materials for heavy clayware and products of heavy clayware

* Importance of fine ceramics.

* How to use resources more efficiently.

* Demonstrate the tests and quality control measures of clay ware products

SYLLABUS

Classification of Whiteware Products: Body formulation and properties, tableware, earthenware talc bodies, vitreous bodies, high alumina bodies, porcelain, bone china, sanitary ware, stoneware, majolica, terracotta, art ware, physical properties of mixtures, role of water.

Whiteware: Classification, body composition, white wares at home, construction, electrical appliances, industrial uses, manufacturing and properties.

Heavy Clayware: Raw materials, methods of winning and handling, classification of building materials, manufacture of building bricks, hollow bricks and other bricks, roof tiles, paving tiles, sewer pipes.

Fine Ceramics: Packing of two component system, porosity, effect of grain size, unfired porosity, experimental verifications, wet to dry contraction, unfired strength, permeability and casting rate, dry to fired contraction.

Tests and Quality Control: IS inspection, LOI, plasticity, strength, MOR, thermal shock resistance, abrasion resistance, porosity, acid and alkali resistance, chipping resistance, chemical analysis, electrical and thermal conductivity.

Text Books:

1. 'Pottery Science: Materials, Processes and Products' by Allen Dinsdale, Ellis Horwood Ltd., New York,

2. 'Ceramic White Ware' by Sudhir Sen, Oxford& IBH Publishing Co., New Delhi

Reference Book:

'Industrial Ceramics' by F. Singer and S. Singer, Oxford & IBH Publishing Company.

3. CERAMIC RAW MATERIALS

Course Objectives:

* To procure knowledge about the earth

* To gain knowledge regarding the rocks which are most useful ores.

* To know about the physical and optical properties of the minerals and ores

* To gain acquaintance with formation of different raw materials.

* To collect information about the different types of clays

* To put on the knowledge regarding other raw materials used in the ceramics

* To get information regarding the distribution of the deposits

Course Outcomes:

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

* Identify the sources/ availability of raw materials for ceramics

* Examine different clays as raw materials for various ceramic products

* Explain the behavior of silicates as ceramic raw materials

* Acquire knowledge about accessory ceramic raw materials.

SYLLABUS

General Geology and Mineralogy: Formation of rocks, their characteristics, classification into igneous, sedimentary and metamorphic groups, formation of mineral deposits, physical and mineral characteristics of minerals – composition, color, streak, luster, fracture, cleavage, hardness, density and tenacity, elements of optical mineralogy.

Clays: Clay minerals, clay structure – kaolinite and montmorillonite groups, geology of clay deposits, their classification - china clay, ball clay, fire clay, building clay etc., beneficiation of clays, mica chlorite, illite group, talc, pyrophyllite, wollastonite group, chemical properties, physical properties.

Fluxes: Soda and potash feldspar, other feldspars, nephlinesyenite, geology of formation, physical and chemical properties, beneficiation.

Silica and Silicate Materials: Silica, polymorphic modification, silica structure, physical and chemical properties of silica, silicate chemistry, minerals, sillimanite, kyanite, and alusite, availability in India and their uses in ceramic industry.

Other Raw Materials: Geology of bauxite, magnesite, dolomite, chrome, limestone, rutile, zircon, beryllia minerals, alumina, carbides, nitrides, properties and uses.

Textbooks:

1. 'Fine Ceramics Technology and Applications' by F.H.Norton, McGraw Hill Publishers, New York,

2. 'Ceramic Raw Materials' by W.E.Worrall, Pergamon press, New York.

Reference Books:

1. 'Forming Minerals' by W.A.Deer, R.A. Howie &J.Rock, Longman Publishers, London

2. 'Properties of Ceramic Raw Materials' by W.Ryan, Pergamon press, 2nd Edition

3. 'Clay Mineralogy' by M.J.Wilson, Chapman & Hall.

4. NANO SCIENCE & TECHNOLOGY

Course Objectives:

* To give foundational knowledge of the Nano scienceand related fields.

* To make the students acquire an understanding the Nano science and Applications

* To help the students understand in broad outline of Nanoscience and Nanotechnology.

Course Outcomes:

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

* Understand the properties of nanomaterials and their applications

* Synthesize nanoparticles

* Characterize nanomaterials

* Scale up the production of nanoparticles

* Understand applications of nanoparticles in nanobiology and nanomedicine

SYLLABUS

General Introduction: Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, anisotropy,

Silicon Carbide: Application of silicon carbide, nano materials preparation, sintering of SiC, X-ray diffraction data, electron microscopy sintering of nano particles, nano particles of alumina and zirconia, nano materials preparation, characterization, wear materials and nano composites,

Mechanical Properties: Strength of nano crystalline SiC, preparation for strength measurements, mechanical properties, magnetic properties,

Electrical Properties: Switching glasses with nanoparticles, electronic conduction with nano particles,

Optical Properties: Optical properties, special properties and the coloured glasses Process of Synthesis of Nano Powders, electro deposition, important nano materials

Investigaing and Manipulating materials in the nanoscale: Electron microscope, scanning probe microscope, optical microscope for nano science and technology, X-ray diffraction

Nanobiology: Interaction between bimolecules and naoparticle surface, different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, application of nano in biology, naoprobes for analytical applications - a new methodology in medical diagnostics and biotechnology, current status of nano biotechnology, future perspectives of nanobiology, nanosensors,

NanoMedicines: Developing of nano-medicines, nanosytems in use, protocols for nanodrug administration, nanotechnology in diagnostics applications, materials for used in diagnostics and therapeutic applications, molecular nanomechanics, molecular devices, nanotribology, studying tribology at nanoscale, nanotribology applications.

Text Books:

1. 'Nano Materials' by A.K.Bandyopadhyay, New Age Publishers
2. 'Nano Essentials'by T.Pradeep, TMH.

5. INDUSTRIAL SAFETY & MANAGEMENT

Course Objectives:

* To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models

* To understand about fire and explosion, preventive methods, relief and its sizing methods

* To analyse industrial hazards and its risk assessment.

Course Outcomes:

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

* Analyze the effects of release of toxic substances

* Select the methods of prevention of fires and explosions

* Understand the methods of hazard identification and prevention.

* Assess the risks using fault tree diagram

* Explain safety management in general and in industry specific

* Plan emergency preparedness and understand the occupational health hazards

SYLLABUS

Introduction :Industrial Safety, Incident, accident, near miss, hazard, risk, emergency, disasters, risk criteria, Safety at work.

Pediction and Evaluation of Unsafe Conditions: Identification of unsafe areas, unsafe acts, manifestation of unsafe conditions to emergency situation, lessons from accidents and disasters, safety audit and its elements, safety in plant layout, equipment design. Construction, erection, commissioning, material handling. Hazards – chemical hazards, thermodynamic hazards, electrical & electromagnetic hazards, mechanical hazards. Risk – Definition, causes, potential and adverse effects.

Hazard Analysis – incident scenarios, residual risk, Concept Hazard Analysis (CHA), Preliminary Process Hazard Analysis PPHA, HAZOP, Fault Tree Analysis (FTA), Event Tree Analysis (ETA).

Risk Assessment – Risk criteria, causes of death/damage, individual risk, societal risk, criteria for acceptable risk tolerable risk, application of risk assessment, computation of fatality rates, severity rates, vulnerability analysis, introduction to computerized risk assessment techniques.

Safety Management (General) – safety policy perceptions, safety organization, safety audit techniques, project and Construction Safety – welding & cutting operations, fabrication, material handling, equipment spacing, safe plant layout procedures, storage tanks, erection & commissioning works, housekeeping methods, maintenance of storage yards, erection & maintenance of electrical panels and MCC rooms, electrical & mechanical safe guarding.

Emergency Preparedness – onsite & offsite emergency preparedness, emergency preparedness plans, site specific action plans and contingency plans, emergency facilities, rehabilitation & rescue operations, post emergency actions.

Safety Management (Industry Specific)- Chemical Manufacturing Plants, Fertilisers, Steel Plants, Petrochemical Plants, Metallurgical Plants, Mineral Process Industries, Sugar plants, semiconductor industry, Polymer manufacturing plans, Paper industry, Pharmaceutical and bulk drug industries, Vessel manufacturing industry, LPG bottling plants, Power Plants, tanneries and textiles.

Statutory Framework – key provisions of Factories Act, Environmental Protection Act, Manufacture, Storage and Import of Hazardous Chemical rules, Static and Mobile Pressure Vessels rules, NFPA specifications, OSHA regulations.

Occupational Health Management – occupational health perspectives, pre-employment & periodical medical examinations, diseases, causes, consequences, Occupational Health Hazards in Various Industries – aluminium industry, asbestos, battery manufacturing, sugar, cement, coke

ovens, cotton ginning, dairy, electro plating, fish canning, poultries, irrigation, lead smelting, mining, pesticides, power plants, refineries, pulp & paper industry, PVC processing, steel plants, fertilizers, sulphuric acid plants, tanneries and textiles.

International Standards – British council's five star rating systems, International Safety Rating Systems (ISRS), ISO 14001 EMS, ISO 18001 OHSAS, BIS 14489 Code of Conduct for conducting safety audits.

Text Books:

1. "Hazards in Chemical industries, 3rd edition" – Authored by Frank P.Lees

2. "Hazard identification and risk assessment" – Authored by Geoff Wells; Published by Institution of Chemical Engineers, Davis Building, 165-189 Railway Terrace, Rugby, Warwickshire CV21 3HQ, UK.

Reference Books:

1. "Safety Management 5th edition" – Authored by John V. Grimaldi and Rollin H. Simonds; Published by A.I.T.B.S. Publishers & Distributors, J-5/6, Krishna Nagar, Delhi – 110051.

2. "Environmental Health and Safety Management" – Authored by Nicholas P. Cheremisinoff and Madelyn L. Graffia; Published by Jaico Publishing House, Hyderabad.

6. FUELS, REFRACTORIES AND FURNACES

Course Objectives:

* The main objective of this course is to study the different minerals used for the manufacturing of different types of refractories and its large scale applications in industries.

Course Outcomes:

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

* Understand the importance, types of refractories, properties, design and installation and different types of coatings on refractories.

* Explain about special refractories

* Describe refractories for iron & steel industry, Glass industry and cement & nonferrous industry

SYLLABUS

Introduction of Refractories: Production, demand and growth of refractories in India – layout of modern refractory plant – fundamental properties of refractories – Indian and international standards – factors for selection and use of refractories – test and quality control procedures.

Silica Refractories: Raw materials and composition – manufacturing process steps – quality of raw materials and process parameter on quartz inversion – glassy phase and other micro structural features – porosity, strength, RUL dependence on micro structure – specifications of silica refractories.

Alumina – Silica Refractories: Al_2O_3 – SiO_2 phase diagram – clay, pyrophyllite, sillimanite, grog, bauxite and diaspore as raw materials – manufacturing processes – micro structure and properties.

Basic Properties: Magnesite, forsterite, dolomite and chrome based refractories – raw materials and composition – manufacturing processes – micro structure and properties.

Special Refractories: Oxide based, carbide based and nitride based refractories – cordierite – zirconia – carbon – fusion cast refractories, slide gate, purging refractories, and continuous casting refractories – ceramic fibres.

Refractories for Iron and Steel Industry: Coke oven, blast furnace, twin hearth, LD converter – continuous casting – electric arc furnace, induction furnaces – reheating furnaces – slide plate system – nozzle, shroud/ SDN – ladle and tundish lining practices – monolithic - gunning techniques – refractor, slag and metal interactions.

Refractories for Cement and Non Ferrous Industry : Wet/ dry process for cement making – preheater and pre calcinatory and zone lining – alkali and wear resistance – refractory requirement and use in copper, aluminum and hydro carbon industry – use of monolithic.

Refractories for Glass Industry : Design of glass tank for container, sheet, lamp, float glasses, refractory practices in side wall, throat, forehearth, and roof of glass tanks – regenerator systems – alumina and AZS fused cast refractories – glass corrosion resistance, oxidation, seed potential tests – glass defects and analysis – feeder expendables.

Refractories for Ceramic Industry: Kiln furniture – types – properties of requirement - silicon carbide, mullite, corderite, alumina, zirconia – mullite, zirconia types – kiln design – LTM concept – fast firing technology.

Refractories for Energy Conservation: Insulation refractories – types-ceramic fiber product – design and installation – ceramic coatings – case studies in ceramic fiber usage.

Textbook:

B. M. Coop and E. M Piekson, Raw Materials for the refractory industries and industry materials and consumer survey, 1981.

Reference Books:

1. J. H. Eheslers Refracrtories: production and Properties. Iron and Steel Institute, London, 1972.

2. Akira Nistrikawa, Technology of monolithic refractories, Plibrico japan co. Tokyo 1984

3. D.N. Nandi, Hand Book Refractory's, Tata Mc Graw hill publishing Co. New Delhi 1991

4. K.Shaw, Refractories and thick uses ADP sciences publisher U K 1972

5. Keishi GOTON, Powder Technology Hand Book, Marcel Dekker Inc. 1997

6. Chester J.H., Steel Plant Refractories, 2nd Edition, 1973, United Steel Companies Limited, Sheffield UK

7. Advances in Refractory Technology, Ed. Robert E Fisher, Ceramic Transaction Vol 4., American Ceramic society, 1990, Westerville, Ohio, USA.

7. BIOCHEMICAL ENGINEERING

Course Objectives:

* To apply the chemical engineering principles in biological systems.

Course Outcomes

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

* Understand cell and enzyme kinetics
* Discuss methods of immobilization
* Calculate volume of a fermentor
* State sterilization methods
* Select downstream process to separate the products
* Estimation using various Bioanlytical techniques

SYLLABUS

Introduction to Biochemical Engineering and Biotechnology: Overall view of biotechnology since its practice–to date, enzyme kinetics, derivation of M.M. equation of single as well as multiple substrates, enzyme inhibition, determination of M.M. parameters, industrial applications of enzymes,

Cell Cultivation & Kinetics: Microbial, animal and plant cell cultivation, cell immobilization, batch growth of cells, yield coefficient, monod growth kinetics,

Analysis and Design of Fermenters: Batch fermenter, mixed flow fermenter (chemostat), plug flow fermenter, mixed flow fermenters in series, and cell recycling,

Genetic Engineering: DNA and RNA, cloning of genes, stability of recombinant microorganisms, gene manipulation,

Sterilization: Sterilization of media and air, thermal death kinetics, design criterion, continuous sterilization methods,

Aeration and Agitation in Fermenters: Correlations of mass transfer coefficient, measurement of interfacial area and gas holdup, power consumption, scale up concepts,

Bioanalytical Techniques: Gas chromatography, thin layer and paper chromatography, HPLC, affinity, gel, adsorption and ion exchange chromatography.

Text Book:

'Biochemical Engineering Fundamentals' 2nd edition by J.E.Bailey and D.F.Ollis, McGraw-Hill Publishers, Newyork, 1986

Reference Books:

1. 'Chemical Engineering' volume-3, 3rd Edition by J.F Richardson and D.G. peacock, (Chapter-5: Biochemical Reaction Engineering), Pergomon Press, U.K, 1994

2. 'Bioprocess Engineering: Basic Concepts' 2nd edition by M.L.Shuler and F.Kargi, Prentice Hall India, New Delhi, 2003

3. 'Biochemical engineering' by D.G. Rao, Tata McGraw-Hill Publishers, New Delhi,

4. 'Biochemical Engineering' by J.M. Lee, Prentice Hall, Englewood Clifts, 1992.

8. INDUSTRIAL POLLUTION CONTROL ENGINEERING

Course Objectives:

* To understand the types of emissions from chemical industries and their effects on environment, remedial measures.

* To enable the students to design water treatment system & to acquire knowledge on proper management of solid wastes.

* To provide a general idea about safety in chemical industries.

Course Outcomes:

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

* Analyze the effects of pollutants on the environment
* Distinguish air pollution control methods
* Assess treatment technologies for wastewater
* Identify treatment technologies for solid waste
* Identify and manage industrial hazards

SYLLABUS

Types of Emission from chemical industries and their effects on environment, Environmental legislation, noise pollution, occupational health hazards, meteriological factors in pollution dispersion (ALP and ELP), plume behaviour and characteristics, chimney design considerations: Plume raise, effective stack height,

Methods of Analysis of Air Pollutants, particulate matter, SO_x, NO_x, CO_x analysis, removal of particulate matters: principles and design of setting chambers, solid traps, cyclone separators, fabric and design of fibre filters, scrubbers and electrostatic precipitators,

General Methods of Control and removal of sulphur dioxide, oxides of nitrogen, organic vapors from gaseous effluents with design aspects, sources of waste waters, effluent guidelines and standards, characterization of effluent streams, oxygen demanding wastes, oxygen sag curve, BOD curve, analysis of water pollutants,

Methods of Primary Treatment: Screening, sedimentation, floatation and neutralization, biological treatment, bacteria and bacterial growth curve, aerobic processes suspended growth processes, activated sludge process, extended aeration, contact stabilization, aerated lagoons and stabilization ponds, attached growth process with design aspects, trickling filters, rotary drum filters, fluidized bed contactors, anaerobic processes,

Methods of Tertiary Treatment: Carbon adsorption, ion exchange, reverse osmosis, ultra filtration, chlorination, ozonation & sonozone process, sludge treatment and disposal,

Solid Waste Management: solid waste collection, transportation, solid waste processing and recovery, hazards in waste management, risk assessment and safety measures, types of hazardous wastes, health effects, safety measures, risk assessment response measures, case studies or pollutants removal and safety measures in fertilizer, petrochemical, paper, pharmaceutical industries and petroleum refinery,

Industrial Safety: Why safety, accidents, causes and remedial measures, safety aspects of site selection, plant layout and unit plot planning, hazards of commercial chemical operations and reactions, safety aspects of process design, instrumentation for safe operations, safety aspects in design and inspection of pressure vessels, effect of toxic agents, toxicity vs hazards, respiratory hazards, safe experimentation and testing of reactions, materials for safety,

Flamable Materials: Fire extinguishing agents and their applications, eye safety in chemical processing, personnel protective equipment, permit systems, hazard evaluation techniques, modern safety management systems, safety effectiveness.

Text Books:

1. 'Environmental Pollution Control', by C.S. Rao, Wiley Eastern Limited

2. 'Safety and Accident Prevention in Chemical Operations' by Fawcett and Wood

Reference Books:

1. 'Environmental Engineering' by Arcdio P.Sincero and Geogoria Sincero

2. 'Loss Prevention in Chemical Industries' by Frank P.Lees

9. CO2 CAPTURE, SEQUESTRATION & UTILIZATION

Course Objectives:

The student will be able to learn

* Global status of CO2 emission and regulatory interventions
* To recover CO2 from power plants
* About the reagents and process to recover CO2
* Utilization of CO2 and Storage systems

Course Outcomes:

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

* Identify the necessity of CO2 capture, storage and utilization
* Distinguish the CO2 capture techniques
* Evaluate CO2 Storage and sequestration methods
* Assess Environmental impact of CO2 capture and utilization

SYLLABUS

Introduction: Global status of CO2emission trends, Policy and Regulatory interventions in abatement of carbon footprint, carbon capture, storage and utilization (CCS&U)

CO2 Capture Technologies from Power Plants: Post-combustion capture, Pre-combustion capture,Oxy-fuel combustion, chemical looping combustion, calcium looping combustion

CO2 Capture Agents and Processes: Capture processes, CO2capture agents, adsorption, ionic liquids, metal organic frameworks

CO2 Storage and Sequestration: Geological sequestration methods, Biomimetic carbon sequestration

CO2 Utilization: CO2derived fuels for energy storage, polymers from CO2, CO2based solvents, CO2to oxygenated organics, Conversion into higher carbon fuels, High temperature catalysis

Environmental Assessment of CO2 Capture and Utilization: Need for assessment, Green chemistry and environmental assessment tools, Life cycle assessment (LCA), ISO standardization of LCA, Method of conducting an LCA for CO2capture and Utilization.

Text Books:

1. Carbon dioxide utilization: Closing the Carbon Cycle, Peter Styring, Elsje Alessandra Quadrelli, KatyArmstrong, Elsevier, 2015,1st Edition.

2. Carbon Capture, Storage and, Utilization: A Possible Climate Change Solution for Energy Industry, GoelM, Sudhakar M, ShahiRV,TERI, Energy and Resources Institute, 2015, 1stEdition.

3. Carbon Capture and Storage, CO2 Management Technologies, Amitava Bandyopadhyay, CRC Press, 2014, 1st Edition.

Reference Books:

1. Calcium and Chemical Looping Technology for Power Generation and Carbon Dioxide (CO2) Capture, Fennell P, Anthony B, Wood head Publishing Series in Energy: No. 82, 2015, 1st Edition.

2. Developments in Innovation in Carbon Dioxide Capture and Storage Technology: Carbon Dioxide Storage and Utilization, Mercedes Maroto-Valer M, Vol 2, Wood head Publishing Series in Energy, 2014, 1st Edition.

3. Fundamentals of Enhanced Oil and Gas Recovery from Conventional and Unconventional Reservoirs, Alireza Bahadori, Elsevier Inc., 2018, 1st Edition.

10. DESIGN OF EXPERIMENTS

Course Objectives:

The student will be able to learn

* The basic guidelines of designing experiments
* Parametric estimation
* Fitting first/second order models
* Optimization of the given problem

Course Outcomes:

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

* Design experiments for a critical comparison of outputs
* Propose hypothesis from experimental data
* Implement factorial and randomized sampling from experiments
* Estimate parameters by multi- dimensional optimization

SYLLABUS

Introduction: Strategy of experimentation, basic principles, guidelines for designing experiments. Simple Comparative Experiments: Basic statistical concepts, sampling and sampling distribution, inferences about the differences in means: Hypothesis testing, Choiceof samples size, Confidence intervals, Randomized and paired comparison design.

Experiments with Single Factor: An example, The analysis of variance, Analysis of thefixed effect model, Model adequacy checking, Practical interpretation of results, Sample computer output, Determining sample size, Discovering dispersion effect, The regression approach to the analysis of variance, Non-parametric methods in the analysis of variance, Problems.

Design of Experiments: Introduction, Basicprinciples: Randomization, Replication, Blocking, Degrees of freedom, Confounding, Design resolution, Metrology considerations for industrial designed experiments, Selection of quality characteristics for industrial experiments. Parameter Estimation.

Response Surface Methods: Introduction, The methods of steepest ascent, Analysis of a second- order response surface, Experimental designs for fitting response surfaces: Designs for fitting the first-order model, Designs for fitting the second-order model, Blocking in response surface designs, Computer-generated (Optimal) designs, Mixture experiments, Evolutionary operation, Robust design, Problems.

Design and Analysis: Introduction, Preliminary examination of subject of research, Screening experiments: Preliminary ranking of the factors, active screening experiment- method of random balance, active screening experiment Plackett-Burman designs, Completely randomized block design, Latinsquares, Graeco-Latin Square, Youdens Squares, Basic experiment-mathematical modelling, Statistical Analysis, Experimental optimization of research subject: Problem of optimization, Gradient optimization methods, Nongradient methods of optimization, Simplex sum rotatable design, Canonical analysis of the response surface, Examples of complex optimizations.

Text Books:

1. Lazic Z.R., Design of Experiments in Chemical Engineering, A Practical Guide, Wiley, 2005.

2. AntonyJ.,Design of Experiments for Engineers and Scientists, Butter worth Heinemann, 2004.

3. Montgomery D.C.,Design and Analysis of Experiments, Wiley, 5th Edition, 2010.

4. Doebelin E. O., Engineering Experimentation: Planning, Execution, Reporting,McGraw- Hill, 1995.

11. RENEWABLE ENERGY SOURCES

Course Objectives:

The student will be able to learn

* Various sources of energy
* Direct/indirect utilization of solar energy
* Wind energy conversion and types of wind machines
* OTEC systems and application of Geothermal energy

Course Outcomes:

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

* Identify the challenges and problems associated with the use of energy sources.
* Illustrate the renewable energy technologies.

* Distinguish conversion technologies for solar, wind, biomass and hydrogen energies

* Evaluate the performance of energy conversion technologies

SYLLABUS

Sources of Energy: Energy sources and their availability, renewable energy sources. Energy from Biomass: Introduction, Biomass as a source of energy, Biomass conversion technologies, Biogas generation, classification of biogas plants, Biomass gasification.

Solar Energy: Sun and solar energy, solar radiation and its measurement, solar energy collectors, solar energy storage, Photovoltaic systems, Application of solar energy

Wind Energy: Wind as an Energy source, Basic principles of wind energy conversion, Types of Wind machines, Components of wind energy conversion system, Performance of wind machines, application of wind energy.

Geothermal Energy: Introduction, Origin and distribution of geothermal energy, types of geothermal resources, Hybrid geothermal power plant, Application of geothermal

Energy Hydrogen Energy: Introduction, Hydrogen production, Hydrogen storage, Hydrogen transportation Energy from the Oceans: Introduction, Ocean Thermal Electric Conversion (OTEC), Energy from Tides, Ocean Waves Chemical Energy Sources. Introduction to Fuel cells, and Batteries.

Text Books:

1. Non-Conventional Energy Sources, Rai, G.D, Khanna Publishers, New Delhi, 2010.

2. Non-conventional Energy Sources, RajeshKumarPrasad, T.P.Ojha, Jain Brothers, 2012.

3. Solar energy–Thermal Collection and storage, SukhatmeS. PandJ. Nayak, Tata McGraw Hill Education Pvt. Ltd., 2008, 3rdEdition.

4. Power Plant Technology, MM. ElWakil, Tata Mc Graw Hill, New York, 1999

12. ENERGY TECHNOLOGIES

Course Objectives:

The student will be able to learn

* Conventional and non conventional energy sources

* Direct solar energy conversion using photovoltaic cells

* Recovery streams of heat from the product streams using waste heat boilers

* Energy conversion and management

Course Outcomes:

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

* Identify the Energy sources and its exploration

* Design process equipment for alternative energy sources

* Explain the principles of solar cells and fuel cells

* Analysis for energy accounting & auditing

SYLLABUS

Conventional Energy Sources: Formation of fossil fuels &resources. Energy sources: Coal; Oil; Natural gas; Hydropower. Coal Gasification & Liquefaction; Synthetic fuels; Hydrogen; Methods & applications of Cogeneration; Fluidized-bed combustion, combined cycle plants. Role of coal in energy crisis.

Non-conventional Energy Sources: Study of power plants using energy sources like solar, wind, geothermal, ocean thermal, tide. Design of Biogas plant; Biomass energy; Alternative fuels from biomass.

Direct Energy Conversion: Solar cells; Photovoltaic cells; Theory of junction-type cells & construction details. Fuel cells: types; practical considerations; construction & working details. Principles of MHD power generation. Nuclear energy: Nuclear fuels; Fission-type reactor.

Waste Heat Recovery: Heat pump; Demand of energy & Forecasting; Principles of energy accounting & auditing; economics; Principles of energy management; Technology assessment with reference to case studies.

Energy Conservation & Management: Energy Scenarioin the World and Indiain 21st century. Exploration of energy resources based on combustion.

Text Books:

1. Energy Technology–Nonconventional, Renewable & conventional, S.Rao, Khanna Publishers, New Delhi.

2. An Introduction to Power Plant Technology, G.D.Rai, Khanna Publishers, NewDelhi.

3. Non-conventional Energy Sources, G.D.Rai, Khanna Publishers ,New Delhi.

HSS ELECTIVES

1. INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

* To familiarize the students with the concepts of Management.

* To relate the concepts of Management with industrial organizations.

* To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.

* To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

* On completion of the course, the students will be able to:

* Understand the roles, skills and functions of management.

* Distinguish the different types of business organizations.

* Identify the factors involved in Production Operations Management.

* Diagnose organizational problems and take suitable decisions.

* Establish good Human Resource Management practices.

* Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

SYLLABUS

Basic Concepts of Management:

Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations: Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and Operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship: Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

1. Industrial Organization & Engineering Economics by Sharma,S.C, and Banga, T.R., Khanna Publishers, Delhi, 2000.

2. The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth) by Vasant Desai, HImalayan Publishing House, 2018.

Reference Books:

1. Management Science, by Aryasri , A.R., McGraw HIll Education (India Private Limited , New Delhi 2014.

2. Entrepreneurship by Sheela, P. and Jagadeswara Rao, K., Shree Publishing House, Guntur, Andhra Pradesh, 2017.

2. ORGANIZATIONAL BEHAVIOUR

Course Objectives:

* To understand the basic concepts of organisational behaviour, its foundations and importance.

* To enable students to have a basic perspective of Motivation and Motivation theories.

* To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

Course Outcomes:

* Indentifying fundamental aspects of organizational dynamics.

* Evaluate main theories of motivation and formulating suitable motivational strategies.

* Analyze the behaviour of individuals and groups in organizations.

* Understanding of Leadership theories and Leadership behaviour.

* Apply relevant theories, concepts to address important Organizational Behaviour questions.

SYLLABUS

Organizational Behaviour : Concept of Organisation - Concept of Organisational Behaviour - Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing to Organisational Behaviour.

Motivation: Définition - Nature of Motivation - Role of Motivation - Théories of Motivation : Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication : Down Ward, Up Ward and Horizontal communication.

Organisational Conflicts: Concept of Conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intra group conflict, Inter group conflict, Inter Organizational conflict - Conflict management.

Organizational Change: Nature - Factors in Organizational change - Planned change: Process of Planned change - Resistance to change: Factors in résistance to change – Over coming résistance to change.

Text Books :

1. Organizational Behaviour by L.M.Prasad: Sultan Chand & Sons, New Delhi -110002

2. Organisational Behaviour by K. Aswathappa:, Himalaya Publishing House, New Delhi

Référence Book :

Organizational Behaviour by Stephen Robbins:, Pearsons Education, New Delhi.

3. OPERATIONS RESEARCH

Course Objectives:

* Formulate a real world problem as a mathematical programming model.

* Provide knowledge of optimization techniques and approaches.

* Understand and study inventory problems.

* Know the network models.

* Put on knowledge in solving replacement problems and different queuing models

Course Outcomes:

* Learned to translate a real-world problem into a mathematical formulation.

* Formulate and Solve Transportation, Assignment and sequencing problems.

* Resolve inventory problems.

* Able to solve maximum flow and shortest path problems.

* Capable to solve replacement problems and analyze queuing models.

SYLLABUS

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - n jobs through two machines; n jobs through three machines; n jobs through m machines; 2 jobs through m machines.

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queuing Models: Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queue with infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Text Books:

1. Operations Research- An Introduction" by Hamdy A Taha, TAHA , Prentice Hall, 2009.

2. "Introduction To Operations Research by F.S. Hiller, G.J. Liberman,B. Nag and P.Basu Mc Graw Hill Education(India), 2012.

3. "Operations Research" by S.D.Sharma Kedarnadh Ramnadh & Co.,2017

Reference Books:

1. "Operations Research" by R. Pannerselvam, PHI..

2. "Operations Research" by Richard Bronson, Schaum's Series, Mc Graw Hill

3. "Operations Research- Theory and Practice" by N.V.S.Raju, BS publications.

4. "Operations Research" by V.K. Kapoor, Sultan Chand & Sons.

B.Tech. (Chemical Engineering)

Scheme & Syllabi

Effective from 2021-22 Admitted Batch

B.Tech. (Chemical Engineering)

I Year - I Semester

Course code	Category	Course Title	Hours per week L	P	Internal Marks	External Marks	Total Marks	Credits
CH-1101	BS	Maths – I	4	0	30	70	100	3
CH-1102	BS	Physics	4	0	30	70	100	3
CH-1103	ES	Engineering Graphics	2	3	30	70	100	3
CH-1104	ES	Material Science & Engineering	4	0	30	70	100	3
CH-1105	ES	Basic Electrical Engineering	4	0	30	70	100	3
CH-1106	ES	Workshop	0	3	50	50	100	1.5
CH-1107	BS	Physics Lab	0	3	50	50	100	1.5
CH-1108	ES	General Engineering Lab. (Mechanical Engineering& Electrical Engineering)	0	3	50	50	100	1.5
		Total Credits						19.5

I Year - II Semester

CH-1201	BS	Maths – II	4	0	30	70	100	3
CH-1202	BS	Chemistry	4	0	30	70	100	3
CH-1203	HSS	English	4	0	30	70	100	3
CH-1204	ES	CPNM	4	0	30	70	100	3
CH-1205	ES	Mechanical Engineering	4	0	30	70	100	3
CH-1206	HSS	English Language Lab	0	3	50	50	100	1.5
CH-1207	BS	Chemistry Lab	0	3	50	50	100	1.5
CH-1208	ES	CPNM Lab	0	3	50	50	100	1.5
		Total Credits						19.5

II Year - I Semester

CH-2101	BS	Maths-III	4	0	30	70	100	3
CH-2102	PC	Fluid Mechanics	4	0	30	70	100	3
CH-2103	PC	Particle and Fluid Particle Processing	4	0	30	70	100	3
CH-2104	PC	Heat Transfer	4	0	30	70	100	3
CH-2105	HSS	Managerial Economics	4	0	30	70	100	3
CH-2106	PC	Fluid Mechanics LAB	0	3	50	50	100	1.5
CH-2107	PC	Particle and Fluid Particle Processing LAB	0	3	50	50	100	1.5
CH-2108	PC	Heat Transfer LAB	0	3	50	50	100	1.5
CH-2109	SC	MATLAB (software training)	1	2	50	50	100	2
CH-2110	MC	Professional Ethics & Universal Human values	0	0	-	100	100	0
CH-2111	MC	NCC/NSS	0	2	-	-	-	0
		Total Credits						21.5

II Year - II Semester

CH-2201	ES	Solid Mechanics	4	0	30	70	100	3
CH-2202	BS	Organic Chemistry	4	0	30	70	100	3
CH-2203	PC	Material and Energy Balances	4	0	30	70	100	3
CH-2204	PC	Chemical Engineering Thermodynamics	4	0	30	70	100	3
CH-2205	PC	General Chemical Technology	4	0	30	70	100	3
CH-2206	PC	Organic Chemistry LAB	0	3	50	50	100	1.5
CH-2207	PC	General Chemical Technology LAB	0	3	50	50	100	1.5
CH-2208	SC	ASPEN PLUS (Process design)	1	2	50	50	100	2
CH-2209	MC	Environmental Science	0	0	-	100	100	0
		Total Credits						20.0

Internship – I

III Year - I Semester

CH-3101	PC	Process Instrumentation and Control	4	0	30	70	100	3
CH-3102	PC	Mass Transfer-I	4	0	30	70	100	3
CH-3103	PC	Chemical Reaction Engineering - I	4	0	30	70	100	3
CH-3104	PE	Professional Elective-I	4	0	30	70	100	3
CH-3105	OE	Open Elective-I	4	0	30	70	100	3
CH-3106	PC	Mass Transfer-I Lab	0	3	50	50	100	1.5
CH-3107	PC	Process Instrumentation and Control Lab	0	3	50	50	100	1.5
CH-3108	SC	Analytical Techniques	1	2	50	50	100	2
CH-3109	INT	Internship – I			50	50	100	2
		Total Credits						22.0

III Year - II Semester

CH-3201	PC	Mass Transfer-II	4	0	30	70	100	3
CH-3202	PC	Chemical Reaction Engineering-II	4	0	30	70	100	3
CH-3203	PC	Chemical Process Equipment Design	4	0	30	70	100	3
CH-3204	PE	Professional Elective-II	4	0	30	70	100	3
CH-3205	OE	Open Elective-II	4	0	30	70	100	3
CH-3206	PC	Mass Transfer-II Lab	0	3	50	50	100	1.5
CH-3207	PC	Chemical Reaction Engineering Lab	0	3	50	50	100	1.5
CH-3208	PC	Chemical Process Equipment Design Lab	0	3	50	50	100	1.5
CH-3209	SC	Soft Skills	1	2	50	50	100	2
		Total Credits						21.5

Internship – II

IV Year - I Semester								
CH-4101	PE	Professional Elective-III	4	0	30	70	100	3
CH-4102	PE	Professional Elective-IV	4	0	30	70	100	3
CH-4103	PE	Professional Elective-V	4	0	30	70	100	3
CH-4104	OE	Open Elective-III	4	0	30	70	100	3
CH-4105	OE	Open Elective-IV	4	0	30	70	100	3
CH-4106	HSSE	HSS Elective	4	0	30	70	100	3
CH-4107	SC	Sustainable Process Engineering	1	2	50	50	100	2
CH-4108	INT	Internship -II			50	50	100	2
		Total Credits						22.0
IV Year - II Semester								
CH-4201	PROJ	Project work			100	100	200	14
		Total Credits						14.0

PROFESSIONAL ELECTIVES

1. Transport Phenomena
2. Fuel Cell Technology
3. Petrochemicals
4. Polymer Technology
5. Process Modeling and Simulation
6. Petroleum Refinery Engineering
7. Multi Component Separation Processes
8. Chemical Engineering Mathematics
9. Fertilizer Technology
10. Computer Aided Design
11. Process Engineering Economics
12. Process Optimization
13. Reservoir Engineering
14. Paper Technology
15. Computer Applications in Chemical Engineering

OPEN ELECTIVES

1. Corrosion Engineering
2. White Ware & Heavy Clay Ware
3. Ceramic Raw Materials
4. Nano Science & Technology
5. Industrial Safety and Management
6. Fuels, Refractories and Furnaces
7. Biochemical Engineering
8. Industrial Pollution Control Engineering
9. CO2 Capture, Sequestration & Utilization
10. Design of Experiments
11. Renewable Energy Sources
12. Energy Technologies

HSS Elective

1. Industrial Management & Entrepreneurship
2. Organizational Behavior
3. Operations Research

CH-1101 MATHEMATICS-I

Course Objectives:

* To transmit the knowledge of Partial differentiation.

* To know of getting maxima and minima of function of two variables and finding errors and approximations.

* To evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

Course Outcomes:

* Find the partial derivatives of functions of two or more variables.

* Evaluate maxima and minima, errors and approximations.

* Evaluate double and triple integrals, volumes of solids and area of curved surfaces.

* To expand a periodical function as Fourier series and half-range Fourier series.

* Have a fundamental understanding of Fourier series and be able to give Fourier expansions of a given function.

SYLLABUS

Partial Differentiation: Introduction - Functions of two or more variables - Partial derivatives - Homogeneous functions – Euler's theorem - Total derivative - Change of variables – Jacobins. Mean value Theorems (without proofs).

Applications of Partial Differentiation: Geometrical interpretation -Tangent plane and Normal to a surface -Taylor's theorem for functions of two variables - Errors and approximations -Total differential. Maxima and Minima of functions

of two variables - Lagrange's method of undetermined multipliers - Differentiation under the integral Sign - Leibnitz's rule.

Multiple Integrals : Introduction - Double Integrals - Change of Order of Integration - Double Integrals in Polar Coordinates - Triple Integrals - Change of Variables.

Multiple Integrals-Applications: Area enclosed by plane curves - Volumes of solids - Area of a curved surface - Calculation of Mass - Center of gravity - Moment of inertia - product of inertia – principal axes- Beta Function - Gamma Function - Relation between Beta and Gamma Functions. Error Function or Probability Integral.

Fourier Series: Introduction - Euler's Formulae - Conditions for a Fourier Expansion - Functions having points of discontinuity - Change of Interval - Odd and Even Functions - Expansions of Odd or Even Periodic Functions, Half-Range Series - Parseval's Formula. Practical Harmonic analysis.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43rd Edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K.International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

6. Higher Engineering Mathematics by Dr. M.K.Venkataraman.

CH-1102 PHYSICS

Course Objectives:

* To impart knowledge in basic concept of physics of Thermodynamics relevant to engineering applications.

* To grasp the concepts of physics for electromagnetism and its application to engineering. Learn production of Ultrasonics and their applications in engineering.

* To Develop understanding of interference, diffraction and polarization: connect it to a few engineering applications.

* To Learn basics of lasers and optical fibers and their use in some applications.

* To Understand concepts and principles in quantum mechanics and Nanopahse Materials. Relate them to some applications.

Course Outcomes:

* Understand the fundamentals of Thermodynamics and Laws of thermodynamics. Understand the working of Carnot cycle and concept of entropy.

* Gain Knowledge on the basic concepts of electric and magnetic fields. Understand the concept of the nature of magnetic materials. Gain knowledge on electromagnetic induction and its applications .

* Understand the Theory of Superposition of waves. Understand the formation of Newton's rings and the working of Michelson's interferometer. Remember the basics of diffraction, Evaluate the path difference. Analysis of Fraunhofer Diffraction due to a single slit

* Understand the interaction of matter with radiation, Characteristics of Lasers, Principle, working schemes of Laser and Principle of Optical Fiber. Realize their role in optical fiber communication.

* Understand the intuitive ideas of the Quantum physics and understand dual nature of matter. Compute Eigen values, Eigen functions, momentum of Atomic and subatomic particles using Time independent one Dimensional Schrodinger's wave equation. Understand the fundamentals and synthesis processes of Nanophase materials.

SYLLABUS

Thermodynamics

Introduction, Heat and Work, First law of thermodynamics and applications, Reversible and Irreversible process, Carnot cycle and Efficiency, Second law of thermodynamics, Carnot's Theorem, Entropy, Second law in terms of entropy, Entropy and disorder, Third law of thermodynamics (statement only).

Electromagnetism

Concept of electric flux, Gauss's law - some applications, Magnetic field - Magnetic force on current, torque on current loop, The Biot-Savart's Law, B near a long wire, B for a circular Current loop, Ampere's law, B for a solenoid, Hall effect, Faraday's law of induction, Lenz's law, Induced magnetic fields, Displacement current, Maxwell's equations (no derivation), Magnetic materials: Classification of magnetic materials and properties.

Ultrasonics : Introduction, Production of Ultrasonics – Piezoelectric and Magnetostriction methods, acoustic grating, applications of ultrasonics.

Optics

Interference: Principles of superposition – Young's Experiment – Coherence - Interference in thin films (reflected light), Newton's Rings, Michelson Interferometer and its applications.

Diffraction: Introduction, Differences between interference and diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a single slit (Qualitative and quantitative treatment).

Polarisation: Polarisation by reflection, refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and Half wave plate, circular and elliptical polarization.

Lasers and Fibre Optics: Introduction, characteristics of a laser beam, spontaneous and stimulated emission of radiation, population inversion, Ruby laser, He-Ne laser, Semiconductor laser, applications of lasers

Introduction to optical fibers, principle of propagation of light in optical fibers, Acceptance Angle and cone of a fibre, Numerical aperture, Modes of propagations, classification of fibers, Fibre optics in communications, Application of optical fibers.

Modern Physics: Introduction, De Broglie concept of matter waves, Heisenberg uncertainty principle, Schrodinger time independent wave equation, application to a particle in a box. Free electron theory of metals, Kronig - Penney model (qualitative treatment), Origin of energy band formation in solids, Classification of materials into conductors, semi conductors and insulators.

Nanophase Materials

Introduction, properties, Top-down and bottom up approaches, Synthesis - Ball milling, Chemical vapour deposition method , sol-gel methods, Applications of nano materials.

Text Books :

1. Physics by David Halliday and Robert Resnick – Part I and Part II - Wiley.

2. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand

3. Engineering Physics by R.K. Gaur and S.L. Gupta –Dhanpat Rai

Reference Books:

1. Modern Engineering Physics by A.S. Vadudeva

2. University Physics by Young and Freedman

CH-1103 ENGINEERING GRAPHICS

Course Objectives:

* Understand the basics of Engineering Graphics and BIS conventions.

* Develop the graphical skills for communication of concepts, ideas and design of engineering products through technical drawings

* Demonstrate and practice the various profiles/curves used in engineering practice through standard procedures.

* Demonstrate and practice the orthographic projections of points, lines, planes, solids and section of solids

* Demonstrate and practice the development of surfaces of simple solids

* Familiarize the basic concept of isometric views clearly.

Course Outcomes:

* Develop simple engineering drawings by considering BIS standards.

* Able to draw different engineering curves with standard Procedures

* Comprehend the basics of orthographic projections and deduce orthographic projections of points, lines, planes and solids at different orientations in real life environment.

* Visualize clearly the sections of solids.

* Apply the concepts of development of surfaces while designing/analyzing any product.

* Recognize the significance of isometric drawing to relate 2D environment with 3D environment.

SYLLABUS

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions, and Scales.

Curves: Conic sections: General construction of ellipse, parabola and hyperbola. Construction of involutes of circle and polygons only. Normal and tangent to curves.

Projections of Points: Principal or Reference Planes, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane.

Projections of Straight Line Inclined to Both the Reference Planes: Projections of Planes: Projection of Perpendicular planes: Perpendicular to both reference planes, perpendicular to one reference plane and parallel to other reference plane and perpendicular to one reference plane and inclined to other reference plane. Projection of Oblique planes. Introduction to Auxiliary Planes.

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to other and axes inclined to both the reference planes.

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids (Prism, Pyramid, Cylinder and Cone) in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Isometric Views: Isometric projection, Isometric scale and Isometric view. Isometric view of Prisms, Pyramids, cylinder, cone, and their combinations.

Text Book:

Elementary Engineering Drawing by N.D.Bhatt, Charotar Publishing House.

Reference Book:

Engineering Graphics by K.L. Narayana and P. Kannaiah, Tata Mc-Graw Hill

CH-1104 MATERIALS SCIENCE & ENGINEERING

Course Objectives:

Materials science and engineering is an important subject to every engineer to understand about the materials' behavior in different environments. Main objectives of the study are as follows:

* To understand the structure of atoms

* To learn something about the crystalline nature of the materials

* To know about the influence of atoms controlling the properties of materials

* To know the equivalency of the materials for replacement

* To learn to prepare alloys, composites for conventional materials

* To find the relation between arrangement an thermodynamic properties of materials

Course Outcomes:

* To know about the appropriate utility of materials based on their nature.

* To know the behavior of the materials w.r.t their directions.

* To know the behaviour of materials exposed to different conditions in different phases.

* To calculate the stability materials and knew the importance of crystalllinity.

* Selectivity of the materials for suitable design to manufacture the machines

* To improve the properties choosing alternative materials suchas alloys, composites instead of conventional materials (to minimize fractures, wear and tear).

* Leads to prepare some knew semiconductors for important purposes.

SYLLABUS

An introduction to materials: Classification of engineering materials, brief review of atomic structure, calculation of energy of electron of Bohr's atomic model, Bonds in materials – classification, properties of ionic, covalent and metallic solids, variation in bonding character and properties. Crystal Geometry and crystal structure – solids- crystalline solids and amorphous solids (non-crystalline), differences between crystalline and non-crystalline materials. Ideal crystal, space Lattice, unit cell, primitive cell, non-primitive cell, lattice co-ordinates, Bravis lattices for crystal systems, crystal systems and their properties, symmetry and elements of symmetry, Atomic packing faction and packing efficiency (SC, BCC, FCC, Diamond cubic and HCP structures), c/a ratio for HCP structure. Miller indices for directions and linear density calculation, planes in crystals and their representation, planar density calculation, coordination number. Determination of crystal Structure by X-ray diffraction method – Debye method, numerical problems for different cubic structures (SC, BCC and FCC).

Fundamentals of Thermodynamics : Stability and meta-stability of materials, internal energy (E), enthalpy (H), Gibb's free Energy (G), and thermal entropy and configurational entropy (S). solid solutions-types, crystal imperfections – classification, point defects- classification and estimation of point defects in the crystals; Imperfections (dislocations) – classification (edge and screw); Berger circuits and Burgers Vector, planar defects, volume defects, dislocation reactions, role of dislocations in determining crystal properties; surface defects - types

Mechanical Properties: Stress –types of stresses; Strain-types of strain; true stress and true strain, engineering stress and engineering strain of the materials, relation between engineering strain and true strain, relation between engineering stress and true stress; Hooke's Law; Poisson's Ratio, stress-strain diagram and its uses; different moduli of elasticity – Young's modulus, shear modulus, and bulk modulus; relation between different moduli of elasticity, strain vs stress relationship diagrams for different materials (metals, non-metals, rubbers and plastics and polymers); elastic deformation and plastic deformation and their differences. Critical Resolved shear stress (CRSS). Fracture – types, ductile fracture and its mechanism, brittle fracture and its mechanism (Griffith's criteria), fatigue factors affecting the fatigue, creep and creep failure mechanisms, creep resistance materials. Composite materials – classification, advantages of composite materials over conventional materials, Limitations of composite materials, factors affecting the performance of fibrous composites, factors affecting the performance of matrix in composites, Phase- time scale for phase changes, Phase diagrams- phase rule, single component systems, Binary phase changes, the lever rule and numerical problems, advantages of phase diagrams, advantages of alloying of metals on the properties of steels, Iron-iron carbide (Fe-Fe_3C) phase diagram, limitations of plain carbon steels, types of steels used in chemical industries,

Corrosion and Prevention: Principles and mechanism of corrosion, types of corrosion cells: composition cell, concentration cell, stress cells, Different forms of corrosion, prevention and control of corrosion: proper selection of materials, proper design and fabrication procedure, application of protective coatings.

Text Books:

1. 'Materials Science & Engineering' by V.Raghavan, Prentice Hall of India Ltd, New Delh

2. 'Elements of Materials Science & Engineering', 5th Edition, Lawrence H.VanVlack, Addision-Weley Publishing Company

Reference Books:

1. 'Science of Engineering Materials', Vols.1-3, by Manas Chanda, McMillan Company of India, Delhi

2. 'Principles of Materials Science & Engineering', William F.Smith, McGraw-Hill Publishing Co.

3. 'Essentials of Materials Science' by A.G. Guy.

4. A textbook of Engineering physics, by Dr.M.N.Avadhanulu and Dr.P.G.Kshirsagar; S.Chand and company pvt Ltd. Chapters 26 and 27.

5. An introduction to corrosion science and engineering By Herbert Uhilig and R. Winston Revie, Published by John Wiley and sons, New York.

6. Corrosion Engineering by Mars.G.Fontana, McGraw-Hill, publication

CH-1105 BASIC ELECTRICAL ENGINEERING

Course Objectives:

* An understanding of basic EE abstractions depends on analysis and design of electric and magnetic circuits and its elements.

* To provide the students with knowledge of fundamental laws in electrical engineering

* To develop the ability of the students to analyze electrical and magnetic circuits using the basic laws of electrical engineering

* To expose the students to the concepts of various types of electrical machines and application of electrical machines.

* To inculcate the understanding about the AC fundamentals

* To prepare the students to have a basic knowledge of transformers

* To acknowledge about three phase induction motor and its operating principle

* To know about the fundamentals of synchronous motors and its working principle

Course Outcomes:

After the completion of the course, the student should be able

* To predict the behavior of any electrical and magnetic circuits.

* student will be able to state and explain the basic laws of electromagnetic induction.

* To impart knowledge on Constructional details, principle of operation, types of Electrical Machines performance Characteristics ,speed control methods and its applications

* Ability to conduct experiments on Ac Machines to find its characteristics.

* Abel to calculate performance characteristics of transformer like regulation and efficiency

* The ability to formulate and then analyze the working of synchronous motors

* Able to solve simple problems on synchronous motors

SYLLABUS

Magnetic Circuits: Definitions of magnetic circuit, reluctance, magneto motive force (mmf), magnetic flux, simple problems on magnetic circuits, hysterisis loss (chapter 8, page nos. 155-175), Electromagnetic Induction: Faraday's laws of electromagnetic induction, induced E.M.F., dynamically induced E.M.F, statistically induced EMF, self inductance, mutual inductance (Chapter 9, page nos. 176-190),

D.C. Generators: D.C generator principle, construction of D.C generator, E.M.F equation of D.C generator, types of D.C generators, armature reaction, losses in D.C generator, efficiency, characteristics of D.C generators, applications of D.C generators (chapter 10, 11, pages 208-238),

D.C. Motors: D.C motor principle, working of D.C motors, significance of back, E.M.F, torque equation of D.C motors, types of D.C motors, characteristics of D.C motors, speed control methods of D.C motors, applications of D.C motor, testing of D.C machines, losses and efficiency, direct load test and Swinburne's test (Chapter 12, 13, page Nos. 239-269),

A.C. Circuits: Introduction to steady state analysis of A.C circuits, single and balanced 3 phase circuits (chapter 16, page nos. 323-348),

Transformers: Transformer principle, EMF-equation of transformer, transformer on load, equivalent circuit of transformer, voltage regulation of transformer, losses in a transformer, calculation of efficiency and regulation by open circuit and short circuit tests (Chapter 20, page Nos. 423-455),

Three Phase Inductance Motor: Induction motor working principle, construction of 3-phase induction motor, principle of operation, types of 3-phase induction motor, torque equation of induction motor, slip-torque characteristics, starting torque, torque under running condition, maximum

torque equation, power stages of induction motor, efficiency calculation of induction motor by direct loading (Chapter 21, page nos. 463-489),

Altemator: Altenator working principle, EMF equation of altenator, voltage regulation by Synchronised impedance method (Chapter 23, page nos. 505-515),

Synchonous motor: Synchronous motor principle of operation, construction, methods of starting of synchronous motor, (Chapter- 24, page nos. 516-526),

Text Book:

'Elements of Electrical Engineering & Electronics' by V.K. Mehta, S.Chand & Co.

Reference Book:

'A first course in Electrical Engineering' by Kothari.

CH-1106 WORKSHOP LAB

Course Objectives:

* Get hands on experience with the working skills in Carpentry trade.

* Know how to work with Sheet Metal tools.

* Get familiar with the working skills of Metal Fitting operations.

* Get hands on experience with house hold electrical wiring.

Course Outcomes:

* Can be able to work with Wood Materials in real time applications.

* Can be able to build various parts with Sheet Metal in day-to-day life.

* Can be able to apply Metal Fitting skills in various applications.

* Can be able to apply this knowledge to basic house electrical wiring and repairs.

SYLLABUS

Carpentry: Any three jobs from – Half lap joint, Mortise and Tenon joint, Half – lap Dovetail joint, Corner Dovetail joint, Central Bridle joint.

Sheet Metal: Any three jobs from – Square tray, Taper tray(sides), Funnel, Elbow pipe joint.

Fitting: Any three jobs from – Square, Hexagon, Rectangular fit, Circular fit and Triangular fit.

House wiring: Any three jobs from – Tube light wiring, Ceiling fan wiring, Stair-case wiring, Corridor wiring.

References Books:

1. Elements of workshop technology, Vol.1 by S. K. and H. K. Choudary.

2. Work shop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.

3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, 4/e Vikas.

CH-1107 PHYSICS LAB

Course Objectives:

* To enable the students to acquire skill, technique and utilization of the Instruments

* Draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.

* To impart the practical knowledge in basic concepts of Wave optics, Lasers and Fiber optics.

* To familiarize the handling of basic physical apparatus like Vernier callipers, screw gauge, spectrometers, travelling microscope, laser device, optical fibre, etc.

Course Outcomes:

* Ability to design and conduct experiments as well as to analyze and interpret

* Ability to apply experimental skills to determine the physical quantities related to Heat, Electromagnetism and Optics

* The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner by performing various relative experiments.

SYLLABUS

1. Determination of Radius of Curvature of a given Convex Lens By forming Newton's Rings.

2. Determination of Wavelength of Spectral Lines in the Mercury Spectrum by Normal Incidence method.

3. Study the Intensity Variation of the Magnetic Field along axis of Current Carrying Circular Coil.

4. Determination of Cauchy's Constants of a Given Material of the Prism using Spectrometer.

5. Determination of Refractive Index of Ordinary ray m_o and Extraordinary m_e ray.

6. Determination of Thickness Given Paper Strip by Wedge Method.

7. Calibration of Low Range Voltmeter.

8. Calibration of Low Range Ammeter.

9. Determination of Magnetic Moment and Horizontal Component of Earth's Magnetic Field.

10. Lees Method - Coefficient of thermal Conductivity of a Bad Conductor.

11. Carey Foster's Bridge – Verification of laws of Resistance and Determination of Specific Resistance.

12. Melde's Apparatus – Frequency of electrically maintained Tuning Fork.

13. Photoelectric cell-Characteristics.

14. Planks Constants.

15. Laser- Diffraction.

CH-1108 GENERAL ENGINEERING LABORATORY

MECHANICAL ENGINEERING LABORATORY

Course Objectives:

* To be aware of the viscosity, flash point of oil samples and calorific value of a gas

* To get knowledge on calibration of pressure gauge, flywheel and torsional pendulum

* To understand the principles and applications of Air compressors and IC engines

Course Outcomes:

* To determine the viscosity, flash point and calorific value of fluids

* To make out the applications of pressure gauge, flywheel and torsional pendulum

* To derive performance parameters related to IC engines and efficiencies of air compressor

Experiments:

1. Find the viscosity of the given sample of oil using Redwood viscometer-1

2. Find the viscosity of the given sample of oil using Redwood viscometer-II

3. Find the flash point of the given sample of oil using Abel's flash point tester

4. To calibrate pressure gauge using standard pressure and standard weights

5. Draw the valve timing diagram of a 4-stroke diesel engine and port timing diagram of a 2-stroke petrol engine

6. Perform load test at full load, half load, ¼ th load on a 4-stroke Ruston engine and draw the performance curves

7. Find the volumetric efficiency, isothermal efficiency of the given compressor

8. To determine the moment of inertia of a fly-wheel and shaft experimentally and compare the values with the calculated values

9. To determine experimentally the calorific value of a gaseous fuel by using Junkers gas calorimeter

10. To determine the modulus of rigidity of the material of the wire by torsional oscillators

ELECTRICAL ENGINEERING LABORATORY

Course Objectives:

This course provides

* Insight of fundamental laws in electrical engineering.

* Deals with the constructional and operational details of DC and AC machines.

* Analyze electrical and magnetic circuits using basic laws of electrical engineering

Course Outcomes:

After the completion of the course, the student should be able to

* Understand the basic laws of electrical and magnetic circuits.

* Analyze the characteristics of DC generator and motors.

* Design of equivalent circuit of transformer.

* Apply the basic knowledge to solve problems on synchronous machines.

Experiments:

1. Study and calibration of ammeter
2. Study and calibration of voltmeter
3. Study and calibration of wattmeter
4. Study and calibration of energy meter
5. Measurement of low resistance (armature)
6. Measurement of medium resistance (field)
7. Measurement of insulation resistance
8. Measurement of filament resistance
9. Verification of KCL and KVC
10. Superposition theorem.
11. Parameters of a choke coil
12. OC and SC tests on transformer

13. Load test D.C. shunt machine

14. OC test on DC,. separately excited machine

15. Swinburne's test

16. 3-phase induction motor (No load and rotor block tests)

17. Alternator regulation by Syn. impedance method

CH-1201 MATHEMATICS – II

Course Objectives:

* The way of obtaining rank, eigen values and eigen vectors of a matrix.

* To know the importance of Cayley-Hamilton theorem and getting canonical form from a given quadratic form.

* To solve the system of equations by using direct and indirect methods.

* To solve first order and higher order differential equations by various methods.

* To obtain the Laplace transforms and inverse Laplace transforms for a given functions and their applications.

Course Outcomes:

* Find rank, eigen values and eigen vectors of a matrix and understand the importance of Cayley-Hamilton theorem.

* Reduce quadratic form to canonical forms and solving linear systems by direct and indirect methods.

* Demonstrate solutions to first order differential equations by various methods and solve basic applications problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling

* Discriminate among the structure and procedure of solving higher order differential equations with constant and variable coefficients.

* Understand Laplace transforms and its properties and finding the solution of ordinary differential equations.

SYLLABUS

Linear Algebra: Rank of a matrix- Echelon form, Normal Form - Solution of Linear System of Equations - Consistency of Linear System of Equations - Direct & Indirect Methods: Gauss elimination method, LU Factorization method, Gauss Seidal Method. Complex Matrices: Hermitian, Skew-Hermitian and Unitary Matrices and their Properties.

Eigen Values and Eigen Vectors : Eigen Values and Eigen Vectors of a Matrix - Cayley-Hamilton theorem - Inverse and Powers of a Matrix using Cayley-Hamilton's theorem and its applications. Diagonalization of a Matrix - Quadratic Forms - Reduction of Quadratic Form to Canonical Form - Nature of a Quadratic Form.

Ordinary Differential Equations of First Order and its Applications:Formation of ordinary differential equations (ODEs) - Solution of an ordinary differential equation - Equations of the first order and first degree - Linear differential equation - Bernoulli's equation - Exact differential equations - Equations reducible to exact equations - Orthogonal Trajectories - Simple Electric (LR & CR) Circuits - Newton's Law of Cooling - Law of Natural growth and decay.

Differential Equations of Higher Order: Solutions of Linear Ordinary Differential Equations with Constant Coefficients - Rules for finding the complimentary function - Rules for finding the particular integral - Method of variation of parameters - Cauchy's linear equation - Legendre's linear equation - Simultaneous linear differential equations.

Laplace Transforms : Introduction - Existence Conditions - Transforms of Elementary Functions - Properties of Laplace Transforms - Transforms of Derivatives - Transforms of Integrals - Multiplication by t^n - Division by t – Evaluation of integrals by Laplace Transforms - Inverse Laplace Transform - Applications of Laplace Transforms to Ordinary Differential Equations - Simultaneous Linear Differential Equations with Constant Coefficients - Second Shifting Theorem - Laplace Transforms of Unit Step Function, Unit Impulse Function and Laplace Transforms of Periodic Functions.

Text Book:

Scope and Treatment as in "Higher Engineering Mathematics", by Dr. B.S. Grewal, 43r^d edition, Khanna publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti., I.K. International publishing house Pvt. Ltd.

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics, by N.P. Bali and Dr. Manish Goyal. Lakshmi Publications.

4. Advanced Engineering Mathematics by H.K. Dass. S. Chand Company.

5. Higher Engineering Mathematics by B.V. Ramana, Tata Mc Graw Hill Company.

CH-1202 CHEMISTRY

Course Objectives:

* To apply the basic knowledge of Chemistry to the Engineering Discipline.

* To develop knowledge about water and its treatment for industrial and potable purposes.

* To develop understanding in the areas of Polymers, Mechanism of Corrosion of Metals and Corrosion Control Methods, Fuels, Lubricants and Nanomaterials for of conducting polymers, bio-degradable polymers and fiber reinforced plastics and apply the knowledge for solving existing challenges faced in various engineering and societal areas.

Course outcome:

* This course applies the basic concepts and principles studied in Chemistry to Engineering.

* It provides an application of chemistry to different branches of engineering

* The students will be able acquire knowledge in the areas of Water Chemistry,Polymers, Corrosion, Fuels and Lubricants and nanomaterials and suggest innovative solutions for existing challenges in these areas.

SYLLABUS

Water Chemistry: Sources of Water – Impurities and their influence of living systems – WHO Limits – Hardness and its Determination – Boiler Troubles and their removal – Water Softening Methods – Lime-Soda, Zeolite and Ion Exchange - Municipal Water Treatment-Break Point Chlorination – Desalination of Sea Water – Reverse Osmosis Method, Electro-dialysis.

Polymers and Plastics:

Polymers: Definition – Types of Polymerization (Addition & Condensation) – Mechanisms of Addition Polymerization – Radical and Ionic – Thermodynamics of Polymerization Process.

Plastics: Thermosetting and Thermoplastics – Effect of Polymer Structure on Properties of Cellulose Derivatives – Vinyl Resins – Nylon (6,6), Reinforced Plastics – Conducting Polymers.

Corrosion: Origin and Theory – Types of Corrosion: Chemical and Electrochemical; Pitting, Inter granular, Waterline, Stress – Galvanic Series – Factors Effecting Corrosion.

Corrosion Controlling Methods: Protective Coatings: Metallic Coatings, Electroplating and Electroless Plating – Chemical conversion Coatings – Phosphate, Chromate, Anodized, Organic Coatings – Paints and Special Paints.

Fuels and Lubricants:

Solid Fuels: Wood and Coal, Ranking of Coal – Analysis (Proximate and Ultimate) Coke Manufacture – Otto Hoffmann's Process – Applications.

Liquid Fuels: Petroleum Refining – Motor Fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane Number; Gaseous Fuels: Biogas, LPG and CNG – Characteristics – Applications.

Rocket Fuels: Propellants – Classification – Characteristics

Lubricants: Classification – Mechanism – Properties of Lubricating Oils – Selection of Lubricants for Engineering Applications.

Nanomaterials: Nanomaterials, Properties and application of fullerenes, fullerols, Carbon nanotubes and nanowires. Synthesis - Top-down and Bottom-up approaches - Nanocomposites - Nanoelectronics- Applications of nanomaterials in catalysis, telecommunication and medicine.

Text Books:

1. Engineering Chemistry – PC Jain and M. Jain – Dhanpath Rai and Sons, New Delhi.

2. A Text book of Engineering Chemistry – S. S. Dara – S. Chand & Co. New Delhi.

Reference Books:

1. Engineering Chemistry – B. K. Sharma – Krishna Prakashan – Meerut.

2. Introduction to Nanoscience - S. M. Lindsay - Oxford University Press

3. Engineering Chemistry - B. L. Tembe, Kamaluddin and M. S. Krishnan, (NPTEL).

CH-1203 ENGLISH

Course Objectives:

* To make students understand the explicit and implicit meanings of a text/topic;

* To give exposure to new words and phrases, and aid to use them in different contexts;

* To apply relevant writing formats to draft essays, letters, emails and presentations; and

* To adapt oneself to a given situation and develop a functional approach to finding solutions: adaptability and problem solving.

Course Outcomes:

* Students will be able to analyse a given text and discover the various aspects related to language and literature;

* Learn the various language structures, parts of speech and figures of speech;

* Develop one's reading and writing abilities for enhanced communication; and

* Learn to apply the topics in real-life situations for creative and critical use.

SYLLABUS

On the conduct of life: William Hazlitt

Life skills: Values and Ethics

If: Rudyard Kipling

The Brook: Alfred Tennyson

Life skills: Self-Improvement

How I Became a Public Speaker: George Bernard Shaw

The Death Trap: Saki

Life skills: Time Management

On saving Time: Seneca

Chindu Yellama

Life skills: Innovation

Muhammad Yunus

Politics and the English Language: George Orwell

Life skills: Motivation

Dancer with a White Parasol: Ranjana Dave

Grammar:

Prepositions – Articles – Noun-Pronoun Agreement, Subject-Verb Agreement – Misplaced Modifiers – Clichés, Redundancies.

Vocabulary:

Introduction to Word Formation – Root Words from other Languages – Prefixes and Suffixes – Synonyms, Antonyms – Common Abbreviations

Writing:

Clauses and Sentences – Punctuation – Principals of Good Writing – Essay Writing – Writing a Summary

Writing: Essay Writing

Life skills: Innovation

Muhammad Yunus

Text Book:

Language and Life: A Skills Approach Board of Editors, Orient Blackswan Publishers, India. 2018.

References Books:

1. Practical English Usage, Michael Swan. OUP. 1995.
2. Remedial English Grammar, F.T. Wood. Macmillan.2007
3. On Writing Well, William Zinsser. Harper Resource Book. 2001
4. Study Writing, Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills, Sanjay Kumar and PushpLata. Oxford University Press. 2011.
6. Exercises in Spoken English, Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

CH-1204 'C'-Programing and Numerical Methods

Course Objectives:

* The course is designed to provide complete knowledge of C language.

* To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

* To provide knowledge to the Students to develop logics which will help them to create programs, applications in C.

* This course aims to identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

* This course provides the fundamental knowledge which is useful in understanding the other programming languages.

Course Outcomes:

* Identify basic elements of C programming structures like data types, expressions, control statements, various simple functions and Apply them in problem solving.

* Apply various operations on derived data types like arrays and strings in problem solving.

* Design and Implement of modular Programming and memory management using Functions, pointers.

* Apply Structure, Unions and File handling techniques to Design and Solve different engineering programs with minimal complexity.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

Introduction to C: Basic structure of C program, Constants, Variables and data types, Operators and Expressions, Arithmetic Precedence and associativity, Type Conversions. Managing Input and Output Operations Formatted Input, Formatted Output.

Decision Making, Branching, Looping, Arrays & Strings: Decision making with if statement, Simple if statement, The if…else statement, Nesting of if…else statement, the else..if ladder, switch statement, the (?:) operator, the GOTO statement., The while statement, the do statement, The for statement, Jumps in Loops ,One, Two-dimensional Arrays, Character Arrays. Declaration and initialization of Strings, reading and writing of strings, String handling functions, Table of strings.

Functions: Definition of Functions, Return Values and their Types, Function Calls, Function Declaration, Category of Functions: No Arguments and no Return Values, Arguments but no Return Values, Arguments with Return Values,

No Argument but Returns a Value, Functions that Return Multiple Values. Nesting of functions, recursion, passing arrays to functions, passing strings to functions, the scope, visibility and lifetime of variables.

Pointers: Accessing the address of a variable, declaring pointer variables, initializing of pointer variables, accessing variables using pointers, chain of pointers, pointer expressions, pointers and arrays, pointers and character strings, array of pointes, pointers as function arguments, functions returning pointers, pointers to functions, pointers to structures-Program Applications

Structure and Unions: Defining a structure, declaring structure variables, accessing structure members, structure initialization, copying and comparing structure variables, arrays of structures, arrays within structures, structures within structures, structures and functions and unions, size of structures and bit-fields- Program applications.

File Handling: Defining and opening a file, closing a file, Input/ Output operations on files, Error handling during I/O operations, random access to files and Command Line Arguments- Program Applications

Numerical Methods: Solutions of Algebraic and Transcendental Equations, Bisection Method, Newton Raphson Method. Newton's forward and backward Interpolation, Lagrange's Interpolation in unequal intervals. Numerical Integration: Trapezoidal rule, Simpson's 1/3 rules. Solutions of Ordinary First Order Differential Equations: Euler's Method, Modified Euler's Method and Runge-Kutta Method.

Text Books:

1. Programming in ANSI C, E Balagurusamy, 6th Edition. McGraw Hill Education (India) Private Limited.

2. Introduction to Numerical Methods, SS Sastry, Prentice Hall

Reference Books:

1. Let Us C ,YashwantKanetkar, BPB Publications, 5th Edition.

2. Computer Science, A structured programming approach using C", B.A.Forouzan and R.F.Gilberg, " 3rd Edition, Thomson, 2007.

3. The C –Programming Language' B.W. Kernighan, Dennis M. Ritchie, PHI.

4. Scientific Programming: C-Language, Algorithms and Models in Science, Luciano M. Barone (Author), Enzo Marinari (Author), Giovanni Organtini, World Scientific.

CH-1205 MECHANICAL ENGINEERING

Course Objectives:

* To be aware of the basics in Thermodynamics

* To get knowledge on applications of steam tables

* To understand the principles and applications of IC engines, compressors and turbines

* To comprehend the principles of belts, chain drives and gears

Course Outcomes:

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

* To Know the thermodynamic laws and various processes

* To make out the applications of steam in boilers and turbines

* To derive the various performance parameters related to IC engines and of air compressors

* To arrive basic needs of working of belts, chain drives and gears

SYLLABUS

Thermodynamics: Definitions, systems, classification of thermodynamic systems, cycles and zeroth law of thermodynamics, first law of thermodynamics, closed system, flow processes, open systems with steady flow process, applications of steady flow energy equation to engineering systems.

Second Law of Thermodynamics: Carnot cycle, inequality of Classius-reversible Carnot cycle, entropy, relation between heat and entropy, general expression for entropy change, entropy change of a perfect gas during various thermodynamic processes, air standard cycles, Otto, diesel, dual combustion cycles.

Properties of Steam and Use of Steam Tables: Boilers, classification steam boilers, simple vertical, Cochran, locomotive boiler, Babcock and Wilcox boiler, steam generation, Rankine cycle.

Impulse and Reaction Turbine: Classification of steam turbines, velocity diagram and power produced in impulse turbine, performance of steam turbines, reduction of rotor speed, I C engines: Classification-main composition of IC engines, carburettor, fuel pump injector, cooling systems for IC engines, working of 2-stroke and 4-stroke petrol and diesel engines, power and efficiency of IC engines.

Reciprocating Air-Compressors: Single stage, work done during cycle, effect of clearance, two stage compressors, condition for minimum work, effect of inter-cooling, efficiency.

Drives: Belts, expression for the ratios of tension on the slack and tight side, power transmitted – V-belts, chain drives, gears – spur, helical, bevel gear, trains simple and compound.

Text Books:

1. A Text Book of Thermal Engineering by R.S.Khurmi and J.K.Gupta

2. 'Theory of Machines' by R.S.Khurmi

Reference Books:

1. 'Engineering Thermodynamics' by P.K.Nag
2. 'Engineering Thermodynamics' by J.B.Jones and R.E.Dugar
3. 'Engineering Thermodynamics' by R.K.Rajput
4. 'Theory of Machines' by Balani

CH-1206 ENGLISH LANGUAGE LAB

Course Objectives:

* To make students recognize the sounds of English through Audio-Visual aids;

* To help students build their confidence and help them to overcome their inhibitions and self- consciousness while speaking in English;

* To familiarize the students with stress and intonation and enable them to speak English effectively; and

* To give learners exposure to and practice in speaking in both formal and informal contexts.

Course Outcomes:

* Students will be sensitized towards recognition of English sound patterns and the fluency in their speech will be enhanced;

* A study of the communicative items in the laboratory will help students become successful in the competitive world;

* Students will be able to participate in group activities like roleplays, group discussions and debates; and

* Students will be able to express themselves fluently and accurately in social as well professional context.

SYLLABUS

Introduction to Phonetics: The Sounds of English (Speech sound – vowels and consonants) - Stress and Intonation - Accent and Rhythm.

Listening Skills: Listening for gist and specific information - listening for Note taking, summarizing and for opinions - Listening to the speeches of eminent personalities.

Speaking Skills: Self-introduction - Conversation Skills (Introducing and taking leave) - Giving and asking for information - Role Play - Just A Minute (JAM) session - Telephone etiquette.

Reading and Writing Skills: Reading Comprehension – Précis Writing - E-Mail writing - Punctuation.

Presentation Skills: Verbal and non-verbal communication - Body Language - Making a Presentation.

Reference Books:

1. Ashraf Rizvi. Effective Technical Communication. Tata McGraw Hill Education Private Limited, New Delhi.
2. Speak Well. Orient Blackswan Publishers, Hyderabad.
3. Allan Pease. Body Language. Manjul Publishing House, New Delhi.

CH-1207 CHEMISTRY LAB

Course Objectives:

* To develop the fine skills of quantitative determination of various chemical components through titrimetric analysis

* To prepare and use ionexchange/ zeolite columns for the removal of hardness of water

* To develop the skill of organic synthesis through the preparation of a polymer/ drug

Course Outcomes:

* The course provides quantitative determine the amount of various chemical species in solutions by titrations and conduct the quantitative determinations with accuracy

* The course provides to develop novel materials to be used as zeolite and prepare columns for removal of hardness of water

* The course provides to synthesise a polymer or a drug

SYLLABUS

1. Determination of Sodium Hydroxide with HCl (Na_2CO_3 Primary Standard)
2. Determination of Alkalinity (Carbonate and Hydroxide) of water sample
3. Determination of Fe(II)/Mohr's Salt by Permanganometry
4. Determination of Oxalic Acid by Permanganometry
5. Determination of Chromium (VI) by Mohr's Salt Solution
6. Determination of Zinc by EDTA method
7. Determination of Hardness of Water sample by EDTA method
8. Determination of Chlorine in water by Iodometric Titration
9. Ionexchange/ Zeolite column for removal of hardness of water
10. Synthesis of Polymer/ drug

Reference Books:

1. Vogel's Quantitative Chemical Analysis – V – Edition – Longman.
2. Experiments in Applied Chemistry (For Engineering Students) – Sinita Rattan – S. K. Kataria & Sons, New Delhi

CH-1208 CPNM LAB

Course Objectives:

* To impart writing skill of C programming to the students and solving problems.

* To write and execute programs in C to solve problems such as Modularize the problems into small modules and then convert them into programs.,

* To write and execute programs in C to solve problems such as arrays, files, strings, structures and different numerical methods.

* This reference has been prepared for the beginners to help them understand the basic to advanced concepts related to Objective-C Programming languages.

Course Outcomes:

* Understand various computer components, Installation of software. C programming development environment, compiling, debugging, and linking and executing a program using the development environment.

* Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.

* Construct programs that demonstrate effective use of C features including arrays, strings, structures, pointers and files.

* Apply and practice logical ability to solve the real world problems.

* Apply Numerical methods to Solve the complex Engineering problems.

SYLLABUS

1. Write a program to read x, y coordinates of 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?

2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (e.g. for, while, and do while).

3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position, Copying one string to another, Reversing a string, adding one string to another.

4. Write a program which determines the largest and the smallest number that can be stored in different data types like short, int, long, float, and double. What happens when you add 1 to the largest possible integer number that can be stored?

5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.

6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).

7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their mean and standard deviation.

8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.

9. Implement bisection method to find the square root of a given number to a given accuracy.

10. Implement Newton Raphson method to det. a root of polynomial equation.

11. Given table of x and corresponding f(x) values, Write a program which will determine f(x) value at an intermediate x value by using Lagrange's interpolation/

12. Write a function which will invert a matrix.

13. Implement Simpson's rule for numerical integration.

14. Write a program to solve a set of linear algebra.

CH-2101 MATHEMATICS-III

Course Objectives:

The objectives, in particular are to learn about:

* Differentiation of vector functions of real variables, curves in space, differential operators, the concept of gradient, divergence and curl and their potential applications.

* The concepts of Line-, Surface and Volume integrals and transformation theorems such as Green's theorem in the plane, Stoke's theorem, Gauss Divergence theorem and their applications.

* Formation of Partial Differential Equations and solution of first order first degree linear, non-linear Partial Differential Equations, Homogeneous and Non homogeneous linear partial differential equations with constant coefficients.

* The method of separation of variables and how to use it to find the solution of one dimensional wave (string equation), one-and two-dimensional Heat flow equations, Laplace's equation in Cartesian and polar coordinates.

* The concept of integral transforms, namely, Fourier transforms, Fourier Sine, Cosine and related inversetransforms, and their applications in solving several Physical and Engineering problems.

Course Outcomes:

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

* Understand differential operations and the concepts of Gradient, Divergence and Curl and their applications.

* Apply the concepts of Line integrals, Surface Integrals, Volume Integrals and their potential applications: work done by a force field, circulation and Flux etc. Also, find out the relation between Line, Surface and Volume integrals: Green's theorem in the plane, Stoke's and Divergence theorems.

* Understand the formation of partial differential equations and the solving Linear and Non linear first order partial differential equations. Also, how to find the solution of Linear Partial Differential Equations with constant coefficients by finding the complementary function and particular integrals.

* Apply the method of separation of variables to solve the important governing equations of one dimensional wave equation, One and Two dimensional heat flow equations, Laplace's equations in Cartesian and polar coordinates.

* Apply the knowledge of Fourier transform techniques in solving several Initial and Boundary value problems of Engineering, such as problems in Conduction of heat / Thermodynamics, Hydraulics transverse vibrations of a string, oscillations of an elastic beam, bending of beams, electrical circuits, free and forced vibrations of a membrane and transmission lines , etc.

SYLLABUS

Vector Calculus-Differentiation: Differentiation of vectors, curves in space, velocity and acceleration, relative velocity and relative acceleration, scalar and vector point functions, vector operator Ñ applied to scalar point functions- gradient, Ñ applied to vector point functions- divergence and curl. Physical interpretation of gradient, divergence and culrl (i.e., ∇f, $\nabla.\overline{F}$, $\nabla\times\overline{F}$), Irrotational and Solenoidal fields, the relations obtained after Ñ applied twice to point functions, Ñ applied to products of two functions.

Vector Integration: Integration of vectors, line integral, circulation, work done, surface integral-flux, Green's theorem in the plane, Stoke's theorem, volume integral, Gauss Divergence theorem. (All theorems without proofs) Introduction of orthogonal curvilinear coordinates, cylindrical and spherical polar coordinates

Partial Differential Equations: Formation of partial differential equations, solutions of partial differential equations- equations solvable by direct integration, linear equations of first order: Lagrange's Linear equation, non-linear equations of first order, Charpit's method. Homogeneous linear equations with constant coefficients- rules for finding the complementary function, rules for finding the particular integral (working procedure), non-homogeneous linear equations.

Applications Of Partial Differential Equations: Method of separation of variables, One dimensional wave equation-vibrations of a stretched string, one dimensional Heat flow equation, Two dimensional heat flow in steady state - solution of Laplace's equation in Cartesian and polar coordinates (two dimensional).

Integral Transforms (Fourier Transform): Introduction, definition, Fourier integral, Sine and Cosine integrals, Complex form of Fourier integral, Fourier transform, Fourier Sine and Cosine transforms, Finite Fourier Sine and Cosine transforms, properties of Fourier transforms. Convolution theorem for Fourier transforms, Parseval's identity for Fourier transforms, Fourier transforms of the derivatives of a function, simple applications to Boundary value problems.

Text Book:

Scope and treatment as in "Higher Engineering Mathematics", by Dr. B.S.Grewal, 43rd Edition, Khanna Publishers.

Reference Books:

1. Graduate Engineering Mathematics by V B Kumar Vatti, I.K.International publications

2. Advanced Engineering Mathematics by Erwin Kreyszig.

3. A text book of Engineering Mathematics by N.P. Bali and Dr. Manish Goyal, Lakshmi Publications.

4. Mathematical Methods of Science & Engineering aided with MATLAB by Kanti B.Dutta, Cengage Learning India Pvt. Ltd.

5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw Hill Company.

6. Advanced Engineering Mathematics by H.K.Dass. S.Chand Company.

CH-2102 FLUID MECHANICS

Course Objectives:

To provide

* Knowledge on pressure distribution in static fluids.

* Knowledge on rheological behavior of fluids, types of fluid flow, boundary layers and basic equations of fluid flow.

* Knowledge of incompressible & compressible fluid flow in pipes

* Knowledge on fluid flowing past solid surfaces

* Knowledge on pipes, fittings, transportation and metering devices.

Course Outcomes:

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

* Derive dimensionless groups by using dimensional analysis.

* Solve problems related to manometers and decanters using the principles of fluid statics.

* Determine the pipe size / flow rate / power requirements under laminar and turbulent flow conditions.

* Solve problems involving motion of particles in fluid, fluid–solid operations in packed beds and fluidized beds.

* Select machinery and measuring devices for fluid flow.

SYLLABUS

Dimensional Analysis: Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis, Buckingham ð theorem, Geometric similarity, kinematic similarity, and dynamic similarity.

Fluid Statics and Applications: Nature of fluids, Hydrostatic Equilibrium, Applications of fluid statics – Manometers, continuous gravity decanter and centrifugal decanter.

Fluid Flow Phenomena: Laminar flow, shear rate, shear stress. Rheological properties of fluids – Newtonian fluids, Non Newtonian fluids, time dependent flow, viscoelastic fluids. Viscosity, Reynolds number, Turbulence - nature of turbulence, deviating velocities, intensity and scale of turbulence, Reynolds stresses and eddy viscosity. Boundary layers - boundary layer formation over flat plate, flow in boundary layers, laminar and turbulent flow in boundary layers, boundary layer formation in straight tubes, boundary layer separation and wake formation.

Basic Equations of Fluid Flow: Continuity equation (Mass Balance in a flowing fluid), equation of motion (Differential Momentum Balance), Navier - stokes equations, Euler's equation, Couette flow, Macroscopic Momentum Balance, layer flow with free surface, Bernoulli equation (Energy equation), corrections for effect of solid boundaries and pump work.

Incompressible Flow in Pipes and Channels : Shear Stress and skin friction in pipes, Relation with skin friction and wall shear, Friction factor, relations between skin friction parameters, equivalent diameter, laminar flow in pipes and channels, velocity distribution, average velocity, Kinetic energy correction factor and momentum correction factor for laminar flow, Hagen-Poiseuille equation, laminar flow of non-Newtonian liquids, laminar flow in annulus. Turbulent flow in pipes and channels, Velocity distribution for turbulent flow, universal velocity distribution equations, its limitations, flow quantities for turbulent flow in smooth round pipes, Reynolds number- friction factor law for smooth tubes, effect of roughness, friction factor chart, drag reduction, friction from changes in velocity or direction – sudden expansion, sudden contraction, pipe fittings, friction losses in Bernoulli equation, velocity heads, separation of boundary layer in diverging channel, minimizing losses.

Flow in Compressible Fluids: Definitions and basic equations, processes of compressible flow, isentropic flow through nozzles, Adiabatic friction flow, Isothermal friction flow

Flow Past Immersed Objects: Drag and drag coefficients, flow through bed of solids, Motion of particles through fluids - mechanics of particle motion, equation for one-dimensional motion of particles through fluid, terminal velocity, criterion for settling, free and hindered settling. Fluidization – conditions, minimum fluidization velocity, types of fluidizations and its applications.

Transportation and Metering of Fluids: Pipes, fittings, valves. Positive displacement Pumps – reciprocating, rotary and peristaltic pumps. Centrifugal pumps - theory, construction, performance, single and multistage pumps. Fans, Blowers and Compressors. Vacuum pumps – jet ejectors.

Metering of Fluids: Full bore meters – Venturi meter, Orifice meter, Rotameters, Vortex-Shedding meters, Magnetic meters and Coriolis meters. Insertion meters – Pitot Tube, Thermal meters, notches and weirs.

Text Book:

"Unit Operations of Chemical Engineering" Seventh Edition, by W.L. McCabe, J C Smith and P Harriot, Mc Graw Hill

Reference Book:

"Chemical Engineering" Volume I by Coulson J.M. and Richardson J.F, Elsevier

"Fluid Mechanics" 2nd edition by Noel de Nevers, Mc Graw Hill.

CH-2103 PARTICLE & FLUID PARTICLE PROCESSING

Course Objectives:

Mechanical Operations is one of the core subjects for chemical engineers, where student can learn some of the unit operations necessary for process industry. Main objectives of the inclusion of this subject are:

* To make the students exposed to different geometrical sizes of raw materials used in the industries, area of calculation of the particles w.r.t their sizes

* To get familiarity with the different laws of grinding

* To do the power consumption calculations

* To learn different separation process on their physical properties

* To differentiate between the process such as mixing and agitation

* To know the movement of particles in different liquids (viscous)

Course Outcomes:

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

* Select suitable size reduction equipment based on performance and power requirement.

* Analyze particle size distribution of solids

* Evaluate solid-fluid separation equipment

* Determine the power required for agitation, blending and mixing

* Select conveyers for the transportation of materials in the industry

SYLLABUS

Characteristics of Solid Particles: shape, size, differential and cumulative screen analysis, specific surface area, particle population, different mean diameters for a mixture of particles.

Principles of Communication: Laws of crushing, description and working of size reduction equipment - jaw, gyratory and roll crushers, hammer mills, revolving mills, attrition mills, fluid energy mill, cutting machines, open and closed circuit grinding, wet and dry grinding, grindability index.

Size Separation: screening, industrial screens - grizzly, gyratory and vibratory screens, revolving screens, trammels, capacity and effectiveness of screens, magnetic separation, electrostatic separation, froth flotation.

Filtration: Description and working of filtration equipment, plate and frame filter press, shell and leaf filters, rotary drum filter, filter aid, centrifugal filtration, top suspended batch centrifuge, theory of filtration, washing of cakes.

Motion of Particles Through Fluids: Drag, free and hindered settling, settling velocities, classification, sink and float methods, differential setting methods - jigging and tabling, cyclone separators.

Batch Sedimentation: Thickeners, flocculation, centrifugal sedimentation, gravity and centrifugal decanters.

Agitation of Liquids: Power consumption in agitated vessels, scale up of agitation equipment, mixing equipment for mixing of solids and pastes, mixers for dry powders, mixing index.

Conveying: types of conveyors – mechanical, belt, chain and screw conveyors, elevators, pneumatic conveyors, size enlargement - need and applications.

Text Book:

'Unit Operations of Chemical Engineering' by W.L. McCabe, J.C. Smith and P.Harriot, McGraw- Hill Book Company

Reference Books:

1. 'Chemical Engineering -Vol.2' by J.H.Coulson and J.F.Richardson, Pergaman press and ELBS

2. 'Chemical Engineer's Hand Book' by R.H.Perry {ed}, McGraw-Hill Book Co.

3. 'Unit Operations' by Brown et al., Asian Publishing House

4. 'Introduction to Chemical Engineering' by Badger and Banchero, McGraw-Hill Book Company

CH-2104 HEAT TRANSFER

Courses Objectives:

* To study the fundamental concepts of heat transfer viz., conduction, convection, radiation.

* To use these fundamentals in typical engineering applications (Heat exchanger and Evaporator, boiling and condensation.) and current research

Course Outcomes:

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

* Analyze problems involving steady state heat conduction in simple geometries

* Develop equations for different types of convection and solve for heat transfer rate by convection in flow through pipes and flow over a flat plate

* Design of shell and tube heat exchangers using LMTD and effectiveness method

* Estimate the rate of radiation heat transfer with and without participating mediumand ability to identify the roll of radiation shields

* Estimate steam economy, capacity of single and multiple effect evaporators

* Understand the concepts of boiling and condensation

SYLLABUS

Nature of Heat Flow: Conduction, convection, natural and forced convection, radiation.

Heat transfer by Conduction : Basic laws of conduction, thermal conductivity; Steady-state conduction – compound resistances in series, heat flow through a cylinder; Unsteady-state conduction – one dimensional heat flow with constant surface temperature, het flow with variable surface temperature, semi-infinite solid.

Heat transfer by Convection: Principles of heat flow in fluids – Typical heat exchange equipment, countercurrent and parallel flows, energy balances, heat flux and heat transfer coefficients, overall heat transfer coefficients, integration over total surface, LMTD, individual heat transfer coefficients.

Heat Transfer to Fluids without Phase Change : Boundary layers, laminar flow heat transfer, correction for heating and cooling, heat transfer in turbulent flow, estimation of wall temperature, cross-sections other than circular, analogy between transfer of momentum and heat, heat transfer to liquid metals, heating and cooling of fluids outside tubes, natural convection.

Heat Transfer to Fluids with Phase Change: heat transfer from condensing vapors, heat transfer to boiling liquids.

Radiation Heat Transfer: Fundamental facts concerning radiation, emission of radiation, absorption of radiation by opaque solids, radiation between surfaces, radiation to semitransparent materials, combined heat transfer by conduction-convection-radiation.

Heat-exchange Equipment: General design of heat exchange equipment, shell and tube heat exchangers, plate-type exchangers, extended surface equipment, heat pipes, scraped-surface exchangers, condensers and vaporizers, heat transfer in agitated vessels, heat transfer in packed beds.

Evaporation: Evaporation, types of evaporators, performance of tubular evaporators, multiple-effect evaporators, methods of feeding, vapor compression.

Text Book:

Unit Operations of Chemical Engineering, 7th Ed. by W. L. McCabe, J. C. Smith and P. Harriot, McGraw Hill International Edition, Singapore (2005).

Reference Book:

Process Heat Transfer, by D. Q. Kern, Tata McGraw Hill, New Delhi.

CH-2105 MANAGERIAL ECONOMICS

Course Objectives:

* To bring about an awareness about the nature of Managerial Economics and its linkages with other disciplines.

* To understand the Micro and Macro Environment of Business.

* To familiarise the prospective engineers with the concepts and tools of Managerial Economics with an objective to understand the real world of business.

Course Outcomes:

* Managerial Economics will help the prospective engineers, who are likely to occupy managerial positions in future to understand the various economic activities in business and industry for an effective and efficient running of the organisations.

SYLLABUS

Significance of Economics and Managerial Economics:

Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand Analysis :Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of Demand - Definition, Measurement of elasticity, Types of Elasticity (Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts' opinion survey method and consumers Survey methods.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations

Theory of Production and Cost Analysis:

Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law

Cost Analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale

Market Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition

Pricing Analysis : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark-down pricing of retailers.

Business cycles, Inflation and Deflation: Business Cycles - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles. Inflation -Meaning, Types, Demand-pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures. Deflation- Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

Text Books:

1. Sankaran,S., Managerial Economics, Marghan Publications, 2015, Chennai.

2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw Hill Education, New Delhi,2015.

CH-2106 FLUID MECHANICS LABORATORY

Course Objectives:

* The student will be exposed to various fluid measuring devices. The pressure drop calculation experimentally across the pipe fittings, valves, packed bed, fluidized bed and annulus will also be dealt in this lab.

Course Outcomes:

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

* Distinguish laminar and turbulent flows.

* Determine the characteristics of flow meters

* Determine the characteristics of packed & fluidized beds and centrifugal pumps

* Calculate pressure drop across a pipe, valves and fittings.

List of Experiments:

1. Identification of laminar and turbulent flows (Reynolds apparatus)
2. Measurement of point velocities (Pitot tube)
3. Verification of Bernoulli equation
4. Calibration of rotameter
5. Variation of orifice coefficient with Reynolds number
6. Determination of venturi coefficient
7. Friction losses in fluid flow in pipes
8. Pressure drop in a packed bed for different fluid velocities
9. Pressure drop and void fraction in a fluidized bed
10. To study the coefficient of contraction for a given open orifice
11. To study the coefficient of discharge in a V - notch
12. To study the characteristics of a centrifugal pump

CH-2107 PARTICLE & FLUID PARTICLE PROCESSING LABORATORY

Course Objectives:

* Solid processing is an essential component in process industries. In the present day, when the world is facing the challenge of dealing with depleting mineral resources, this subject assumes high importance to the students of chemical engineering. The student is introduced to the concepts of sampling, processing of solid raw materials. The student also gets hands on training on operating various machines used for processing of solids.

Course Outcomes:

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

* Select suitable methods for size reduction of minerals or other intermediates

* Analyze particle size distribution of solids

* Evaluate suitable mechanical separations of powders, solid-liquid and solid-gas mixtures

List of Experiments:

1. To take a representative sample from a bulk by two methods, viz. Riffle and cone & quartering and to find out the average size (volume-surface mean diameter) of the samples
2. To determine the grindability index {GI} of coal by hard groove machine
3. To determine the time of grinding in a ball mill for producing a product with 80% passing a given screen
4. To verify the laws of crushing using any size reduction equipment like crushing rolls, ball mill or vibrating mill and to find out the work Index {WI} of the material
5. To compare open circuit and closed circuit grinding by means of a ball mill
6. To determine the optimum time of sieving for a given sample of material
7. To find the effectiveness of hand screening of a given sample by a given screen
8. To find the screen effectiveness of a trommel
9. To separate a mixture of coal into two fractions using sink and float method
10. To separate a mixture of coal into two fractions using froth flotation technique
11. To find the size analysis of a given fine sample using beaker decantation method
12. To separate a mixture of particles by jigging
13. To concentrate a given material by means of tabling
14. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions
15. To determine the specific cake resistance and filter medium resistance of a slurry in plate and frame filter press.

CH-2108 HEAT TRANSFER LABORATORY

Course Objectives:

* The student will calculate the thermal resistance and calculation of heat transfer coefficients for both natural and forced convection scenarios. The student will conduct experiments to calculate emissivity of the given plate, radiation constant of the given rod and Stefen Boltzman constant.

Course Outcomes:

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

* Determine thermal conductivity of composite solids and thermal conductivities of lagging material in lagged pipe apparatus.

* Determine heat transfer coefficients in forced and natural convection.

* Determine the Stefan Boltzmann constant and emissivity of the given plate.

* Calculate radiation constant for hot rod loosing heat to the infinite stagnant ambient.

* Analyze the heat exchanger performance(double pipe) for co-current and counter-current flows and determine overall heat transfer coefficient.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
2. Determination of total thermal resistance and thermal conductivity of Lagged pipe.
3. Determination of the natural convective heat transfer coefficient for a vertical tube.
4. Determination of forced convective heat transfer coefficient for air flowing through a pipe.
5. Determination of over-all heat transfer coefficient in double pipe heat exchanger.
6. Study of the temperature distribution along the length of a pin fin under natural and forced convection conditions.
7. Estimation of unsteady state film heat transfer coefficient between the medium in which the body is cooled.
8. Determination of Stefan-Boltzmann constant.
9. Determination of emissivity of a given plate at various temperatures.
10. Determination of radiation constant of a given surface.
11. Determination of the thermal conductivity of a metal rod.
12. Determination of critical heat flux point for pool boiling of water

CH-2109 MATLAB

Course Objectives:

* The student will learn to apply the knowledge of MATLAB for solving Chemical Engineering problems.

Course Outcomes:

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

* Apply MAT Lab to create and print arrays and execute function files

* Solve linear equations using MAT Lab

* Determine the curve fit equation for the given data

* Draw 2D plots and 3D plots for the given data

SYLLABUS

Introduction: Tutorial lessons: MATLAB session, working with arrays of numbers, creating and printing simple data, saving and executing a script file, creating and executing function files, working with files and directories.

Interactive Computation: Matrices and vectors, matrix and array operations, creating and using inline functions, using built in functions and online help, saving and loading data, plotting simple graphs.

Script files: function files, language specific features, advanced data objects.

Applications: linear algebra, curve fitting and interpolation, data analysis and statistics, numerical integration, ordinary differential equations, nonlinear algebraic equations.

Basic 2D plots: using subplot to layout multiple graphs. 3-D plots, symbolic Math tool box: two useful tools in symbolic Math tool box, using symbolic Math tool box.

Text Book:

'Getting started with MATLAB: A quick introduction for scientists and engineers' by Rudra Pratap, Oxford University press

CH-2110 PROFESSIONAL ETHICS AND UNIVERSAL HUMAN VALUES

Course Objectives:

The objective of the course is :

* Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

* This course will illuminate the students in the concepts of laws and its applicability to engineers.

* Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.

* Strengthening of self-reflection, Development of commitment and courage to act and also enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and professional lives.

* To enable the students to imbibe the Values and Ethical Behavior in the personal and Professional lives.

* The students will learn the rights and responsibilities Individual, employee, team member and a global citizen.

Course Outcomes:

By the end of the course Student will be able to:

* Grasp the meaning of the concept – Law and also Get an overview of the laws relating to Engineers and also Apprehend the importance of being a law abiding person and They would have better critical ability.

* Self-explore by using different techniques to live in harmony at various levels.

* Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life.

* Students are expected to become more aware of themselves and their surroundings (family, society, nature).

* They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

* They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society.

SYLLABUS

Need, Basic Guidelines, Content and Process for Value Education :Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation - as the process for self-exploration, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking, Include practice sessions and case studies.

Understanding Harmony in the Human Being - Harmony in Myself: Understanding human being as: a co-existence of the sentient 'I' and the material 'Body', the needs of Self ('I') and 'Body' - happiness and physical facility, the Body as an instrument of 'I' (I being the doer, seer and enjoyer), the characteristics and activities of 'I' and harmony in 'I', the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, P to ensure Sanyam and Health, Include practice sessions and case studies.

Understanding Harmony in the Family and Society - Harmony in Human – Human Relationship: Understanding values in human-human relationship: meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, the meaning of Trust; Difference between intention and competence, the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, the harmony in the society (society being an extension of family), Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order from family to world family, Include practice sessions and case studies.

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all – pervasive space, Holistic perception of harmony at all levels of existence, Include practice sessions and case studies.

Concept of Law and Law of Torts :Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations, Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities/Duties Hiring Practices, Introduction to Intellectual Property Law, Professional Code of Conduct for Engineers, Relationship between Law and Ethics, Include practice sessions and case studies.

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically

responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Include practice sessions and case studies.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

3. R. Subramanian, "Professional Ethics", Oxford University Press.

4. S.B. Srivasthva, "Professional Ethics & Human Values", SciTech Publications (India) Pvt. Ltd. New Delhi.

5. D.R. Kiran, "Professional Ethics & Human Values", TATA Mc Graw Hill Education.

6. Saroj Kumar, "Business Law" and Avtar Singh, "Law of Contract"

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.

2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book), Mohandas Karamchand Gandhi "The Story of My Experiments with Truth", E. FSchumacher. "Small is Beautiful", Slow is Beautiful –Cecile Andrews, J C Kumarappa "Economy of Permanence", Pandit Sunderlal "Bharat Mein Angreji Raj" and Dharampal, "Rediscovering India

4. G K Kapoor, "Business Law" and Sen & Mitra, "Business & Commercial Laws" and Calvin Frank Allen, "Business law for Engineers"

5. Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). Introduction to Psychology. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.

6. Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi

7. Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.

8. Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, "Engineering Ethics, Concepts Cases: 4e, Cengage learning, 2015.

9. Caroline Whitbec, " Ethics in Engineering Practice & Research: 2e, Cambridge University Press 2015.

CH-2111 NCC/NSS

All the students should enroll either in NCC or NSS and get a satisfactory report.

CH-2201 SOLID MECHANICS

Course Objectives:

* To impart knowledge about the behaviour of elastic bodies subjected to different types of external forces.

* To impart skills of analysing the statically determinate beams subjected to different types of loads for shear force, bending moment and their corresponding stress distribution.

* To develop skills to analyse shafts, springs and shells for determining the critical stress distribution

Course Outcomes:

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

* Analyse different bodies subjected to different types of loads like axial forces, transverse loads and torsional moment.

* Analyse the statically determinate beams subjected to loads.

* Analyse shafts, springs and shells.

SYLLABUS

Axial loads: Simple stress and strain, Hook's law, load extension diagram for mild steel, stress in compound assemblies, thermal stresses.

Transverse loads: Shear force and bending moment diagrams for a) cantilevers, b) simply supported beams and c) over-hanging beams due to concentrated loads and U D L s only.

Theory of simple bending: Relation between i) f and y, ii) M and I, iii) E and R, distribution of shear stress in common shapes of cross-section.

Principal stresses and principal planes, maximum shear stress and its plane, Mohar's circle of stress.

Torsion of solid and hollow circular shafts, transmission of horse power, design of flange coupling, closed coil helical spring i) under axial load and ii) under axial twist, riveted joints, design of lap joints.

Stress in thin cylindrical shells and spherical shells, stress in thick cylinders, compound cylinders, pressure due to shrink-fitting.

Text Book:

'Strength of Materials' by Ramamrutaham

Reference Book:

'Elements of Strength of Materials' by S.P.Timoshenko and D.H.Young, East West Press, New Delhi

CH-2202 ORGANIC CHEMISTRY

Course Objectives:

The student will be able to:

* appreciate the nature and scope of organic chemistry.

* apply key concepts from general chemistry including electronegativity, bonding (ionic and covalent), hybridization of atomic orbitals, and molecular orbital theory to organic systems.

* draw skeletal structures for organic compounds.

* apply acid-base concepts to organic systems; predict ordering of acid or base strength.

* name alkanes, alkenes, polyenes, alkynes, alkyl halides, aromatic compounds, carbonyl compounds, amines and their various derivatives using systematic (IUPAC) nomenclature.

* draw reaction mechanisms for some key reactions.

* recognize stereochemistry and be able to apply the Cahn-Ingold-Prelog system to designation of stereochemistry (E/Z or R/S).

* learn many of the reactions of alkanes, alkenes, polyenes, alkynes, aromatic, carbonyl, and amine compounds, and close related species. Be able to predict reactions involving these functional groups.

* be able to solve problems employing spectroscopic methods including mass spectrometry, infrared and NMR spectroscopy.

* understand the basic chemical and structural features of biomolecules, including lipids, carbohydrates, amino acids and proteins, and nucleic acids.

Course Outcomes:

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

* Determine the molecular formula for organic compounds

* Differentiate the structure and properties of biomolecules, polymers and heterocyclic compounds

* Identify the role of chemical engineer in modern drug discovery programs

* Separate the racemic mixtures using resolution methods

* Elucidate the structure of organic compounds (small molecules) using spectroscopic methods.

SYLLABUS

Numerical Problems: Determination of percentage composition of carbon, hydrogen and nitrogen, molecular weight determination by depression in freezing point and elevation of boiling point methods, molecular weight of acids by silver salt method; molecular weight of bases by chloroplatinate method, determination of molecular formula of a compound, problems relating to reactions of carboxylic acids, functional derivatives of acids, carbonyl compounds, alcohols, amines, phenols, diazonium salts applications, alkenes and their laboratory tests,

Nomenclature of alkanes, alkenes, alkynes, dienes, cyclic aliphatic hydrocarbons, structure of benzene, nomenclature of benzene derivatives, arenas, industrial preparation of ethylene, acetylene; sp, sp^2 and sp^3 hybridization; preparation and chemical reactions; conformational analysis of ethane, propane and butane, Wurtz reaction, Diels-Alder reaction, aromaticity Morkovinkov rule, Clemmensen and Wulf-Kishner reduction,

Electro-philic and Nucleo-philic Aromatic Substitution: Orientation in desubstituted benzenes, mechanism of nitration, halogenation, sulphonation, Friedel-Craft's alkylation and acylation reactions, nomenclature of alkyl halides, preparation and chemical reactions, mechanisms of SN_1, SN_2, E_1, E_2 reactions, nomenclature of aryl halides, preparation and chemical reactions: low reactivity of vinyl and aryl halides, Sandmeyer reaction,

Nomenclature of Alcohols; industrial preparation of ethyl alcohol, preparation and chemical reactions, Lucas test, nomenclature of mono, dicarboxylic acids, industrial preparation of formic, acetic, benzoic, phthalic, salicylic acids, preparation and chemical reactions, mechanism of HVZ reaction and Claisen condensation, nomenclature of functional derivatives of acids, preparation and chemical reactions, mechanism of Hoffmann bromamide reaction, acid and base catalyzed hydrolysis of ester, nomenclature of ethers and epoxides, industrial preparation of ether and ethylene oxide, preparation and chemical reactions; Williamson's synthesis,

Nomenclature of Aldehydes and Ketenes: Industrial preparation of formaldehyde, acetaldehyde, benzaldehyde, salicyaldehyde, acetone; preparation and chemical reactions; mechanisms of Cannizaro, Aldol, Reformatsky and Wittig reactions, reactions without mechanisms -Perkin, Cope, Knoevenagel and Pinacol-Pinacolone reactions, difference between aldehyde and ketone, nomenclature of phenols, industrial preparation of phenol, preparation and chemical reactions, mechanisms of Fries rearrangement, Kobe reaction, Reimer-Tiemann reaction, classification of carbohydrates, structure of glucose and fructose, reactions of glucose and fructose, Ruff degradation, Wohls degradation, filiani-Fisher synthesis, glucose into fructose, fructose into glucose, glucose to vitamin-C, mechanism of Osazone formation,

Nomenclature of amines, industrial preparation of aniline, preparation and chemical reactions - exhaustive methylation, mechanism of Hoffmann elimination, benzedene rearrangement without mechanism, Hinsberg test, differentiation test using nitrous acid, preparation of diazonium salts and synthetic applications, preparation of sulphanilamide, sulphaguanidine, sulphamerazine, sulphapyridene (sulpha drugs), mode of action of sulpha drugs,

Preparation of Soaps and Detergents: Mode of action of soaps, differences between soaps and detergents; preparation of malonic, acetoacetic ester and their synthetic applications, preparation of Grignard reagents and their synthetic applications, preparation of polyethylene, polystyrene, teflon, PVC, polyvinyl cyanide, rubber-vulcanisation, styrene-butadiene rubber, polychloroprene, bakelite, nylon-6 and nylon 6-6, plexiglas, terylene, Ziegler-Natta polymerization, definition of thermoplastics and thermosetting plastics,

Isomerism: Structural and optical isomerism, geometrical isomerism, E Z configuration, sequence rules, R & S configuration, racemic mixture and their separation, asymmetric synthesis - Fischer projection formula, definitions of axial and equatorial bonds, 1-3- diaxial interaction, enatiomers, diastereomers, mesomers, isomerism in cyclic compounds, chair, boat and twisted boat structures (1-methylcyclohexane, 1, 2-cyclohexane diol), sSynthetic applications of - Zn/Hg, Na-$NH_3$$LiAH_4$, $NaBH_4$, diborane and zinc dust, soda lime, OsO_4, hydroxylamine, acetic anhydride, benzoylchloride and PCl_5.

Reference Books:

1. 'Text Book of Organic Chemistry' by Morrison & Boyd
2. 'Text Book of Organic Chemistry' by Bahl&Tuli
3. 'Text Book of Organic Chemistry' by M.K.Jain
4. 'Text Book of Organic Chemistry' by I.L.Finar (Vols.1&2 as reference books)

CH-2203 MATERIAL & ENERGY BALANCES

Course Objectives:

* To give intensive quantitative training in the practical applications of the principles of physical chemistry to the solution of complicated industrial problems and in methods of predicting missing physicochemical data from generalized principles.

Course Outcomes:

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

* Convert physico-chemical quantities from one system of units to another.

* Identify basis and degrees of freedom.

* Perform material and energy balances on single units without and with chemical reactions.

* Solve the material and energy balance problems on multi-unit processes with recycle, purge and bypass.

* Analyze the ideal and real behavior of gases, vapors and liquids.

SYLLABUS

Stoichiometry and Composition Relationships: The gram-mole and pound-mole, limiting reactant, excess reactant, degree of completion, basis of calculation, weight percent, volume percent and mole percent, density and specific gravity- Baume and API gravity scales.

Behavior of Ideal Gases: Application of the ideal-gas law, Dalton and Amagat laws to gaseous mixtures, composition of gases on dry basis and on wet basis.

Vapor Pressures: Effect of temperature on vapor pressure, Antoine equation, reference substance vapor pressure plots, vapor pressure of immiscible liquids, ideal solutions and Raoult's law, non-volatile solutes.

Humidity: Percentage saturation, relative saturation or relative humidity, dew point, vaporization, condensation, wet and dry bulb temperatures, adiabatic vaporization and adiabatic saturation temperature.

Material Balances: Tie substance, yield, conversion, processes involving chemical reactions, material balance- calculations involving drying, dissolution, and crystallization, processes involving recycle, bypass and purge.

Heat Capacities of Gases and Gaseous Mixtures: Effect of temperature on heat capacity of gas, mean heat capacity of gas, Kopp's rule, latent heats, heat of fusion, heat of vaporization, Trouton's rule, Kistyakowsky equation for non-polar liquids, estimation of latent heat of vaporization using Classius-Clayperon equation, enthalpy of humid air and humid heat capacity.

Standard Heat of Reaction: Standard heat of formation, laws of thermochemistry, standard heat of combustion, calculation of heat of formation from heats of combustion, calculation standard heat of reaction from heats of formation and from heats of combustion, standard integral heat of solution, effect of temperature on heat of reaction, Kirchoff's equation, adiabatic and non-adiabatic reactions, theoretical and actual flame temperatures.

Text Book:

'Chemical Process Principles, Part-I - Material and Energy balances' by Olaf A Hougen, K.M. Watson and R.A.Ragatz, CBS Publishers and Distributors (1995)

Reference Books:

1. 'Basic principles and Calculations in Chemical Engineering' by David M. Himmelblau, Prentice Hall of India Pvt Ltd, 1995

2. 'Stoichiometry' by B.I. Bhatt and S.M. Vora, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi (1996)

3. 'Stoichiometry for Chemical Engineers' by Williams and Johnson, McGraw Hill Publishers.

CH-2204 CHEMICAL ENGINEERING THERMODYNAMICS

Course Objectives:

Knowledge of thermodynamics helps student compute heat and work requirements of a process.

The student would also learn

* How to estimate data in case of absence of experimental data.

* Solution thermodynamics and its applications.

* Concept of Phase & Chemical reaction equilibrium.

Course Outcomes:

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

* Apply the first and second laws of thermodynamics to chemical processes and Compute the properties of ideal and real gas mixtures.

* Evaluate heat effects involved in industrial chemical processes.

* Evaluate the efficiency of expansion and compression flow processes and analyze refrigeration and liquefaction processes.

* Determine thermodynamic properties of gaseous mixtures and solutions, Estimate Bubble-P & T, Dew-P & T for binary and multi-component systems and Calculate vapor-liquid equilibrium (VLE) composition for ideal and non-ideal systems.

* Determine equilibrium constant and composition of product mixture for single and multiple reactions.

SYLLABUS

The First Law and other Basic Concepts: Introduction to Basic laws and Terminologies in Thermodynamics- Statement of First law, the steady-state, steady-flow process, the reversible process.

Volumetric Properties of Pure Fluids: PVT behavior of pure substances, the ideal gas, virial equations and its applications, cubic equations of state, generalized correlations for gases and liquids.

Heat Effects: Latent heats of pure substances, Temperature dependence of heat effects of chemical reactions.

The Second Law of Thermodynamics: Statements of second law- Clausius Inequality-Mathematical Statement of Second law, Third law of thermodynamics.

Thermodynamic Properties of Pure Fluids: Property relations for homogeneous phases, residual properties.

Solution Thermodynamics: chemical potential, partial properties, ideal gas mixtures, fugacity and fugacity coefficient for a pure species and species in solution, generalized correlations for the fugacity coefficients, the ideal solution, excess properties. VLE-Duhem's theorem, VLE- qualitative behavior, Raoults law and modified Raoults law, dew point and bubble point calculations, flash calculations.VLE for Ideal solutions, Calculation of activity coefficients.

Chemical Reaction Equilibria: Criteria for chemical reaction equilibrium, the standard Gibbs energy change and the equilibrium constant, Effect of temperature, pressure, composition and other factors.

Text Book:

'Introduction to Chemical Engineering Thermodynamics' by J.M.Smith, H.C.Van Ness and M.M.Abbott., 6th Edition, Tata McGraw-Hill Edition 2003.

Reference Books:

1. 'Chemical Engineering Thermodynamics' by B.F.Dodge, McGraw-Hill Book Co.,

2. 'Schaum Outline of Theory and Problems of Thermodynamics' by Michael M. Abbott and Hendrick C.VanNess, McGraw-Hill International Book Co., Singapore, 1981.

3.'Chemical Engineering Thermodynamics' by Y.V.C.Rao, University Press (India) Ltd., Hyderabad 1997.

4. K.V.Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI Learning, 2004.

CH-2205 GENERAL CHEMICAL TECHNOLOGY

Course Objectives:

* To provide the student understanding of importance of chemical process industries over the other manufacturing industries.

* To provide the brief introduction of chemical process equipments, the application of thermodynamics, the chemical process principles, the equipment design and also the corrosion and the safety aspects to consider in the chemical manufacturing processes.

* To provide basic inorganic chemistry background required for the undergraduate students of engineering.

* To provide an overview of chemical properties of inorganic chemicals and the manufacturing processes.

* To provide an overview of applications of materials which the engineers are likely to use during their professional career.

Course Outcomes:

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

* Selection of a process for manufacture of chemicals

* Draw process flow diagrams

* Identify the engineering problems in chemical processes

* List chemical reactions and their mechanism involved

SYLLABUS

Nitrogen industries: Manufacture of ammonia, nitric acid, urea and ammonium nitrate.

Phosphorous and phosphoric acid industries: Methods for production of phosphorous and phosphoric acid, manufacture of super phosphate and triple super phosphate.

Cement: Types of cement, manufacture of ordinary Portland cement, slag cement.

Coal and Coal chemicals: distillation of coal and coal tar, low and high temperature carbonization of coal.

Petrochemicals: Derivatives of C_2: Polyethylene, Ethanol, Ethylene oxide; Derivatives of C_3: Isoproponol, Acetone, Propylene oxide

Extraction of Vegetable Oils: Purification, acid value, hydrogenation of oils, Manufacture of fatty acids, soaps and detergents classification and manufacture.

Paints and Varnishes: Constituents of paints, functions of paint, manufacturing procedures, Pigments-manufacture of lithophone, varnishes

Manufacture of Pulp and Paper: Kraft process and sulphite process, production of paper

Manufacture of Sugar

Textbooks:

1. "Dryden's Outlines of Chemical Technology" by M.Gopala Rao & Marshall Sitting (Editors). Affiliated East West Press Pvt. Ltd.

2. "Shreve's Chemical Process Industries" by G.T.Austin, McGraw Hill Books

Reference Book:

"Encyclopedia of Chemical Technology" by R.E.Kirk & D.F.Othmer (Editors)Interscience.

CH-2206 ORGANIC CHEMISTRY LABORATORY

Course Objectives:

* The student will learn to analyze the organic compounds. The students will be exposed to the preparation of various organic chemicals in this laboratory.

Course Outcomes:

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

* Analyze and identify the given organic compound

* Prepare organic compounds like aspirin, benzanilide, m-dinitrobenzene, benzoic acid, phthalimide, methyl orange, parabenzoquinone and nerolin

* Identify extra elements

List of Experiments:

1. Preparation of aspirin
2. Preparation of benzanilide
3. Preparation of m-dinitrobenzene
4. Preparation of benzoic acid
5. Preparation of phthalimide
6. Preparation of methyl orange
7. Preparation of parabenzoquinone
8. Preparation of nerolin
9. Detection of extra elements
10. Analysis of compound -1
11. Analysis of compound -2
12. Analysis of compound -3
13. Analysis of compound -4
14. Analysis of compound -5
15. Analysis of compound -6

CH-2207 GENERAL CHEMICAL TECHNOLOGY LABORATORY

Course Objectives:

* The student will be made familiar with analysis of water, oils, coal, lime stone, bleaching powder saw dust etc. and preparations of soap, copper and chrome yellow pigments, Phenol formaldehyde resins.

Course Outcomes:

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

* Synthesize products such as soap, phenol formaldehyde resin, Chrome yellow pigment, and Copper pigment

* Estimation of total solids, dissolved solids,pH, chlorides, sulphates, temporary and permanent hardness in water

* Analyse acid value, Iodine value and sopanification value of oil

* Estimate the purity of various materials

List of experiments:

A. Analysis of water:

1. Total solids, dissolved solids,pH

2. Chlorides and sulphates

3. Temporary, permanent and total hardness.

B. Analysis of oils:

4. Acid value

5. Iodine value

6. Saponification value

C. Miscellaneous analysis:

7. Analysis of coal: Proximate analysis

8. Analysis of lime: Estimation of acid insoluble's, available lime and calcium carbonate

9. Analysis of bleaching powder: Estimation of chlorine content.

10. Analysis of starch/glucose: Estimation of total reducing sugars

11. Analysis of saw dust: Estimation of total cellulose and –cellulose

E. Miscellaneous preparations:

12. Preparation of soap

13. Preparation of copper pigment

14. Preparation of chrome yellow pigment

15. Preparation of phenol formaldehyde resin

CH-2208 ASPEN PLUS (Process Design)

Course Objectives:

* To familiarize students with basic programming skills required for solving chemical engineering problems.

* To analyze the data obtained from simulation with theoritcal concepts.

* To compare different thermodynamic property estimation methods and analysing the results.

* To familiarize students with fundamental applications of chemical engineering in ASPEN PLUS.

Course Outcomes:

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

* Carry out thermodynamic property estimations using Aspen

* Simulate Mixer, splitter, pumps, compressors and flash units

* Apply sensitivity, design specification and case study tools in Aspen

* Design heat exchangers, reactors and distillation columns

* Optimize process flowsheets using sequential modular and equation oriented approaches.

SYLLABUS

Solve the following steady state simulation exercises using Aspen:

1. Physical property estimations.

2. Simulation of individual units like, mixers, splitters, heat exchangers, flash columns and reactors

3. Design and rating of heat exchangers

4. Design and rating of distillation columns.

5. Mass and Energy balances.

6. Handling user specifications on output streams – Sensitivity and design Spec tools.

7. Simulation of a flowsheet

8. Simulation exercises using calculator block

9. Optimization Exercises

10. Simulation using equation oriented approach

Text Books:

1. Lab manuals / Exercise sheets

2. A.K.Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall India, 3rd Edition, 2018.

CH -2209 ENVIRONMENTAL SCIENCE

Course Objectives:

* The aim of this course is to make the students better understand the changes in the environment and be given a greater voice and planning conservation through an interdisciplinary environmental science curriculum that is design to enhance scientific enquiry and to strengthen competence.

Course Outcomes:

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

* Understand various types of pollution regulations and their scientific bases.

* Apply knowledge for the protection and improvement of the environment.

* Recognize the major concepts in environmental science and demonstrating in-depth of the environment

SYLLABUS

Introduction: Definition, scope and importance, measuring and defining environmental development – indicators.

Ecosystems: Introduction, types, characteristic features, structure and functions of ecosystems – forest, grassland, desert, aquatic (lakes, rivers and estuaries).

Environmental and Natural Resources Management: Land resources-land as a resource, common property resources, land degradation, soil erosion and desertification, effects of modern agriculture, fertilizer-pesticide problems.

Forest Resources: use and over-exploitation, mining and dams –their effects on forest and tribal people,

Water Resources: use and over utilization of surface and ground water, floods, droughts, water logging and salinity, dams-benefits and costs, conflicts over water,

Energy Resources: Energy needs, renewable and non-renewable energy sources, use of alternate energy sources, impact of energy use on environment,

Bio-diversity and its Conservation: Value of bio-diversity- consumptive and productive use, social, ethical, aesthetic and option values, bio-geographical classification of India - India as a mega diversity nation, threats to biodiversity, hot spots, habitat loss, poaching of wild life, loss of species, seeds etc., conservation of biodiversity - in-situ and ex-situ conservation,

Environmental pollution- local and global issues: Causes, effects and control measures of air pollution, indoor air pollution, water pollution, soil pollution, marine pollution, noise pollution, solid waste management, composting, vermiculture, urban and industrial wastes, recycling and re-use, nature of thermal pollution and nuclear hazards, global warming, acid rain , ozone depletion,

Environmental problems in India: Drinking water, sanitation and public health, effects of activities on the quality of environment, urbanization, transportation, industrialization, green revolution, water scarcity and ground water depletion, controversies on major dams – resettlement and rehabilitation of people: problems and concerns, rain water harvesting, cloud seeding and watershed management,

Economy and environment: The economy and environment interaction, economics of development, preservation and conservation, sustainability: theory and practice, limits to growth, equitable use of resources for sustainable lifestyles, environmental impact assessment,

Social issues and the environment: Population growth and environment, environmental education, environment movements, environment versus development,

Institutions and governance: Regulation by Government, monitoring and enforcement of environmental regulation, environmental Acts, water (prevention and control of pollution) act, air (prevention and control of pollution) act, environment .protection act, wild life protection act, forest conservation act, coastal zone regulations, institutions and policies relating to India, environmental governance,

International conventions: Stockholm conference-1972, Earth summit-1992, World commission for environmental development (WCED),

Case studies: Chipko movement, Narmada bachao andolan, Silent valley project, Madhura refinery and Taj mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna sagar, Tehri dam, Ralegaon siddhi (Anna Hazare), Kolleru lake-aquaculture, Fluorosis in Andhra Pradesh,

Field work: Visit to a local area to document and mapping environmental assets –river/forest/grass land / hill/ mountain, study of local environment-common plants, insects, birds, study of simple ecosystems – pond, river hill, slopes etc, visits to industries- water treatment plants, effluent treatment plants.

Text Book:

Environmental Studies by Anubha Kaushik & C.P. Kaushik, Second Edition, New Age International (P) Limited.

CH-3101 PROCESS INSTRUMENTATION AND CONTROL

Course Objectives:

In studying this course Chemical Engineering students will come to know the measurement of various process variables and acquire the knowledge of the operation of various process control systems effectively. The students learn

* How physical quantities are measured and how they are converted to electrical or other forms.

* To use various types of instruments.

* Represent the processes in terms of mathematical equations

* The concept of stability and know how to operate a control system in a stable way.

* To deal with various controllers and their functions and applications.

Course Outcomes:

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

* Recommend suitable instrument for the measurement temperature

* Select a method of measurement for pressure,composition, flow and level

* Develop transfer functions for the processes

* Examine the stability of various control systems

* Apply advanced control schemes for processes and identify the characteristics of control valves

SYLLABUS

Qualities of Measurement: The elements of instruments, static and dynamic characteristics, dynamic response of first order and second order instruments.

Expansion Thermometers: Temperature scales, constant-volume gas thermometer, bimetallic thermometer, pressure spring thermometer, theory of volumetric and pressure thermometers, static accuracy of thermometer, comparison of pressure-spring thermometers.

Thermoelectric Temperature Measurement: Thermoelectricity, industrial thermocouples, thermocouple lead wires, thermal wells, response of thermocouples, the mill voltmeter.

Resistance Thermometers: Thermal coefficient of resistance, industrial resistance thermometer bulbs, resistance thermometer circuits, null-bridge resistance thermometers, deflectional resistance thermometers.

Radiation Temperature Measurement: Introduction, blackbody devices and radiation receiving elements, radiation pyrometers, photoelectric pyrometers and optical pyrometers.

Methods of Composition Analysis: Spectroscopic analysis, absorption, Emission and Mass spectroscopy- IR, UV absorption and mass spectrometers, Gas analysis by thermal conductivity, analysis of moisture in gases (humidity), psychrometer method, hygrometer method, dew-point method for moisture analysis in gases, measurement of moisture in paper, textile and lumber.

Measurement of Pressure and Vacuum: Pressure, vacuum and head, liquid column manometers, measuring elements for gauge pressure and vacuum, indicating elements for pressure gauges, measurement of absolute pressure, measurement of pressure in corrosive fluids, static accuracy of pressure gauges.

Measurement of Head and Level: Density and specific gravity, direct measurement of liquid level, pressure(level) measurement in open vessels, level measurement in pressure vessels, density measurement, level measurement by weighing.

Introduction to Process Dynamics and Control: Response of First Order Systems - Physical examples of first order systems. Response of first order systems in series, higher order systems: Second order and transportation lag.

Control systems: Controllers and final control elements, Block diagram of a chemical rector control system Closed loop transfer functions, Transient response of simple control systems.

Stability Criterion: Routh Test, Root locus. Transient response from root locus, Application of root locus to control systems Introduction to frequency response, Control systems design by frequency response.

Advanced control strategies: Cascade control, Feed forward control, ratio control, Smith predictor, dead time compensation, internal model control. Controller tuning and process identification. Control valves.

Text Books:

1. Donald P Eckman. Industrial Instrumentation, CBS Publishers, New Delhi, 2004.

2. D.R. Coughanowr. Process Systems Analysis and Control, Mc Graw Hill, 1991

Reference Books:

1. Hand Book of Instrumentation and control, Considine.

2. Chemical Process Control, G. Stephanopolous, Prentice Hall, 1984.

CH-3102 MASS TRANSFER –I

Course Objectives:

* To explain the students with the basic principles of mass transfer operations and other separation processes with examples.

* To impart knowledge on how certain substances undergo the physical change with diffusion/mass transfer of components from one phase to other phases.

* To describe the students with equipment used in operations involving mass transfer and other separation processes and their advantages and disadvantages.

* To focus on absorption and distillation operations and the process design aspects of the same operations.

* To provide the knowledge on humidification and dehumidification operations and their applications in real situations

Course Outcomes:

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

* Identify diffusion phenomena in various chemical processes

* Determine diffusivity coefficient in gases and liquids.

* Calculate mass transfer coefficients at interfaces of multiphase mass transfer systems

* Understand the VLE concepts and application to different distillations

* Understand the importance of humidification and dehumidification processes and their industrial applications

* Design equipment for gas-liquid mass transfer operations

SYLLABUS

Introduction: Mass transfer Operations.

Molecular Diffusion in Fluids: Binary solutions, Fick's law, equation of continuity, Steady state equimolal counter current diffusion, Stefan's diffusion, estimation of diffusivity of gases and liquids, application of molecular diffusion.

Mass Transfer Coefficients: Mass transfer coefficients in turbulent flow, theories of mass transfer, analogy between momentum, heat and mass transfer in laminar and turbulent flow, correlations for mass transfer coefficients in simple situations, diffusion in solids.

Interphase Mass Transfer: Concept of equilibrium, diffusion between phases, two resistance theory, material balances in steady state co-current and counter-current stage processes, Murphy stage efficiency.

Equipment for Gas-liquid Operations: Sparged vessels, mechanically agitated vessels for single phase liquids and gas-liquid mixtures, tray towers, sieve tray for absorption and distillation, venturi scrubbers, spray towers and spray chambers, packed towers for absorption and distillation, tray towers versus packed towers.

Humidification operations: Definition of fundamental terms, Psychrometric charts, theory of adiabatic saturation and wet bulb temperature, Lewis relation, gas-liquid contact operations, water cooling with air, dehumidification of air-water-vapor mixture, cooling towers, evaporative cooling.

Absorption: Solubility's of gases in liquids, two component systems, multi-component systems, ideal and non-ideal solutions, choice of solvent for absorption, single component absorption material balances, counter current multistage operations, dilute gas mixtures, on-isothermal operation, tray efficiency, continuous contact equipment, HETP, HTU, NTU concepts for single operation absorption with chemical reaction.

Distillation: Principles of VLE for binary systems, phase diagrams, relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation, steam distillation, continuous distillation, McCabe-Thiele method, Ponchon-Savarit method, tray efficiencies, introduction to multi-component distillation, azeotropic and extractive distillations.

Text Book:

Mass transfer Operations, Robert E. Treybal, 3rd edition, McGraw-Hill Book Co.,

Reference Books:

1. "Unit Operations in Chemical Engineering" by McCabe, W.L., Smith, J.C. and Harriot,P., 5th Edition, McGraw-Hill Book Co.,

2. "Chemical Engineering Hand Book" by J.H. Perry.

CH-3103 CHEMICAL REACTION ENGINEERING – I

Course Objectives:

* To learn principles of rate law and stoichiometry. Isothermal reactors-Batch, plug flow reactor and mixed flow reactor. Design of single and multiple reactors.

* To endow with the knowledge on thermal characteristics of various reactions

Course Outcomes:

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

* Derive the rate law for non-elementary chemical reactions and determine the kinetics of chemical reaction using integral, differential and fractional life methods.

* Design reactors for homogenous reactions under isothermal conditions for single and multiple reactions

* Select optimal sequence in multiple reactor systems

SYLLABUS

Introduction and overview of chemical reaction engineering – Variables affecting a chemical reaction – Kinetics of homogeneous reactions – Concentration dependent term of rate equation – Elementary and nonelementary reactions – Temperature dependent term – Arrhenius law, activation energy, collision theory, transition state theory Searching for a mechanism.

Interpretation of batch reactor data – Methods of analysis, integral, differential and half life methods – Analysis of different types of reactions, irreversible and reversible – Variable volume reactor.

Ideal reactors for a single reaction – Performance equations for batch, mixed flow and plug flow reactors – Space time, space velocity and mean residence time.

Design for single reactions – Size comparison of reactors – Multiple reactor systems – Recycle reactor.

Design for parallel reactions – Qualitative and quantitative discussion about product distribution.

Design for series reactions – Qualitative and quantitative discussion about product distribution.

Text Book:

"Chemical Reaction Engineering"., Levenspiel, O. 3rd Edition, John Wiley and Sons.

Reference Books:

1. “Chemical Engineering Kinetics” Smith, J.M, 3rd Edition. McGraw Hill Inc.

2. “Elements of Chemical Reaction Engineering”., Fogler, H.S, 3rd Edition, Prentice Hall India Ltd.

CH-3106 MASS TRANSFER-I LABORATORY

Course Objectives:

* The student will be made familiarised with distillation process and will be able to determine liquid and vapour diffusion coefficient. The student will be able to calculate VLE, HTU, HETP and rate of evaporation by conducting experiments.

Course Outcomes:

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

* Determine separation performance of batch distillation, steam distillation, sieve plate and packed bed distillation

* Estimate the diffusion coefficient of vapour in gas

* Estimate the diffusion coefficient of liquid

* Determine the rate of evaporation

List of Experiments:

1. Steam distillation
2. Differential distillation
3. Height equivalent to a theoretical plate
4. Vapor-liquid equilibria
5. Determination of liquid diffusion coefficient
6. Determination of vapor diffusion coefficient
7. Surface evaporation
8. Height of a transfer unit

CH-3107 PROCESS INSTRUMENTATION & CONTROL LABORATORY

Course Objectives:

* To understand the dynamic behavior of the systems.

* To evaluate response of fist and higher order characteristics.

* Study the installed characteristics of the valve.

* Study if there is a hysteresis in the control valve and sensor.

* Evaluate the tuning of a PID control via manual and automatic tuning.

Course Outcomes:

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

* Identify the dynamics of first order, second order, interacting and non-interacting processes.

* Determine control valve characteristics.

* Evaluate the hysteresis characteristics of Bourdon pressure gauge.

* Implement PID controller on a level control, temperature control and pressure control process.

* Demonstrate PID control trainer.

List of experiments:

1. Response of mercury-in glass thermometer.
2. Response of mercury-in glass thermometer with thermal well.
3. Calibration & response of resistance thermometer.
4. Response of manometer.
5. Calibration of thermocouples.
6. Response of single-tank liquid level system.
7. Response of two-tank non-interacting liquid level system.
8. Response of two tank interacting liquid level system.
9. Study of on-off control – Control let off position.
10. Valve characteristics of equal % control valve.
11. Valve characteristics of linear control valve.
12. On-off control – controller on position.
13. Studies on hysteresis characteristics of Bourdon pressure gauze.
14. Hysteresis characteristics of equal % control valve.
15. Studies on hysteresis characteristics of linear control valve.
16. Response studies for different types of controller (P, PI, PID) using PID control trainer.
17. Level control trainer.
18. Pressure control trainer.
19. Temperature control trainer.

CH-3108 ANALYTICAL TECHNIQUES

Course Objects:

* To give hands on training to the student to analyze different industrial products using various instruments.

Course Outcomes:

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

* Conduct titrations using conductivity meter, potentiometer and pH meter.

* Estimate amount of metal present in the given solution

* Determine analytically different analytes like metal ions, highly conjugated organic compound and biological macromolecules using UV-Spectroscopy.

* Analyze industrial product like fertilizers, cement, pesticides, steel plate.

List of Experiments:

1. Conductivity meter
2. pH meter
3. UV Spectrophotometer
4. Potentiometer
5. Electro gravimetric analysis
6. Thin Layer Chromatography (TLC)
7. Cement analysis
8. Fertilizer analysis
9. Pesticide analysis

CH-3109 SUMMER INTERNSHIP PROGRAM (Evaluation)

Evaluation of Summer Internship / Community Service in the industries / nearby villages which was carried out after 2nd year 2 semester during summer vacation.

CH-3201 MASS TRANSFER –II

Course Objectives:

* To explore about different mass transfer operations and its applications in industrial scale.

Course Outcomes:

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

* Analyze VLE, LLE, and SLE data

* Select a suitable mass transfer operation for a given separation

* Determine number of stages in distillation, extraction and adsorption operations

* Estimate the height of packed column in distillation, extraction and adsorption operations

* Calculate drying rates and moisture content for batch and continuous drying operations

SYLLABUS

Liquid-liquid operations: Extraction: Introduction, liquid-liquid equilibria, analytical and graphical solutions for single and multistage operations, continuous counter current operation without and with reflux, fractional extraction, equipment for liquid-liquid contacting operations, single stage, multistage and continuous contacting equipment,

Leaching: Preparation of solid, steady and unsteady state operation, equipment, analytical methods both theoretical and problematic approaches for single and multistage operations,

Adsorption: Theory of adsorption, Industrial adsorbents, adsorption equilibria, Freundlich equation, single and multistage operations, unsteady state adsorption, equipment for single stage and continuous contact, ion-exchange,

Drying: Equilibria, drying rate curve, batch and continuous drying, time of drying and calculations, mechanism of batch drying, equipment's for batch and continuous drying operations,

Crystallization: Equipment and analytical methods, factors governing nucleation and crystal growth rates, controlled rate of crystals, incorporation of principles into the design of the equipment,

Less conventional operations: Dialysis, thermal diffusion, mass diffusion,

Membrane separation processes: Separation of gases, separation of liquids, dialysis, membranes for liquid extraction, pervaporation, reverse osmosis.

Text Book:

'Mass Transfer Operations', by Robert E.Treybal, III Edition, McGraw-Hill Book Co.

Reference Books:

1. 'Unit Operations in Chemical Engineering' by McCabe,W.L., Smith, J.C. and Harriot, P., 5th Edition, McGraw-Hill Book Co.
2. 'Chemical Engineering Hand Book' by J.H.Perry

CH-3202 CHEMICAL REACTION ENGINEERING-II

Course Objectives:

* To endow with the knowledge on thermal characteristics of various reactions

* To accomplish knowledge on non-ideal reactors

* To impart the knowledge on heterogeneous reacting systems

* To study the design aspects of heterogeneous catalytic systems

* To impart the knowledge on mass transfer with reaction situations

Course Outcomes:

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

* Explain the thermal characteristics and design of adiabatic reactors for single and multiple reactions

* Apply the non-ideality concepts in the reacting system for better understanding the deviations from ideality

* Apply the tanks-in-series model, and the dispersion (single parameter) models for a first-order reaction, to account for the non ideality

* Develop the progressive conversion model and shrinking core model for explaining the fluid particle reaction

* Understand the principles and mechanism involved in heterogeneous catalysis and analyze the data of heterogeneous catalytic reactions.

* Understand the rate controlling mechanisms in heterogeneous catalysis and their rate determinations

SYLLABUS

Temperature and pressure effects – Heats of reaction and temperature – Equilibrium constants from thermodynamics – Equilibrium conversion – General graphical design procedure – Optimum temperature progression – Adiabatic operations.

Non ideal flow – Basics – C,E and F curves – Conversion in non ideal flow reactors – Dispersion model – Tanks-in-series model.

Heterogeneous catalysis – Physical adsorption – Chemisorption – Catalytic properties – Estimation of surface area, pore volume and porosity – Catalyst preparation – Catalyst poisons – Catalytic deactivation.

Solid catalysed reactions – Rate equations – Pore diffusion combined with surface kinetics – Thiele modulus – Effectiveness factor – Performance equations for reactions containing porous catalyst particles – Experimental methods for finding rates – Determining controlling resistances.

Noncatalytic systems – Design of fluid-fluid reactors – Factors to consider in selecting a contractor – Various contractors and contacting patterns for G/L reactions.

Design of fluid particle reactions – Progressive Conversion Model (PCM), Shrinking Core Model (SCM) – Comparison – Controlling mechanisms – Determination of rate controlling step.

Text Book:

'Chemical Reaction Engineering' Levenspiel O, 3rd Edition, John Wiley & Sons.

Reference Books:

1. "Chemical Engineering Kinetics' by Smith, J.M. 3rd Edition, McGraw Hill Inc.

2. "Elements of Chemical Reaction Engineering" by Fogler, H.S, 3rd Edition, Printice Hall India Ltd.

CH-3203 CHEMICAL PROCESS EQUIPMENT DESIGN

Course Objectives:

* This subject introduces the student to the science and art of chemical engineering design. By applying all the knowledge acquired so far, the student will be trained to develop project reports and to carryout design calculations of various process equipment. Finally the student will be able to come out the investment needed for a particular process and also finds out the returns on investment.

Course Outcomes:

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

* Develop process design

* Enumerate general design consideration

* Design incompressible/compressible flow systems and estimate cost of filters

* Select high and low pressure vessels

* Design of distillation column, heat exchangers and evaporators

SYLLABUS

Introduction of Plant Design and Costs, Process Design Development: Design project procedure, design information from the literature and other sources of information, flow diagrams, preliminary design, comparison of different processes, firm process design, equipment design and specialization, scale up in design, safety factors specifications, materials of construction,

General Design Considerations: Health and safety hazards, fire and explosion hazards, personnel safety, loss prevention, thermal pollution control, noise pollution and control, plant location, plant layout, plant operation and control, utilities, structural design, storage, materials handling, materials and fabrication selection.

Material Transfer, Handling and Treatment Equipment Design and Costs: Pumps and piping, frictional effects due to end losses, fittings, orifices and other installations, piping standards, pumps, tanks, pressure vessels and storage equipment, filters.

Mechanical Design of Process Equipment: Design and selection of storage vessels and low pressure vessels, design of roofs, bottom plates, formed heads, flat plate and conical closures, tall vertical columns, supports to process vessels, distillation columns, heat exchanges, evaporators.

Heat Transfer Equipment Design and Costs: Basic theory of heat transfer, consideration in selection of heat transfer equipment, General methods for process design of heat exchangers, evaporators.

Mass Transfer Equipment Design: Finite stage and continuous contactors, plate and column efficiencies, other design factors for finite stage contactors, packed towers, relative merits of plate and packed towers, mass transfer equipment costs, reactors.

Text Books:

1. 'Plant design & Economics for Chemical Engineers', 4th edition, M.S.Peters&K.D.Timmerhaus, McGraw Hills Publishing Company

2. 'Process Equipment Design', 3rd Edition, M.V.Joshi, MacMillan India Ltd 1981

Reference Books:

1. 'Process-Plant-Design' by J.R.Backhurst&J.H.Harker, Heieman Education London

2. 'Chemical Engineering' Volume-VI (An introduction to Chemical Engineering Design) by J.M.Coulson & J.F.Richardson

CH-3206 MASS TRANSFER-II LABORATORY

Course Objectives:

* The student will learn about the LLE, dynamics and mass transfer in spray tower, packed tower and sieve tray tower.

* The students will learn the drying characteristics of the given solid material.

Course Outcomes:

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

* Determine the LLE

* Determine the critical moisture content in drying

* Determine separation performance and mass transfer coefficients of sieve plate

* Identify the axial mixing characteristics in packed bed

* Evaluate the dynamics of liquid drops

List of experiments:

1. Ternary liquid equillibria (Binodal curve)
2. Liquid-liquid equilibria.
3. Limiting flow rates in spray tower
4. Hydrodynamics of perforated plate tower
5. Volumetric mass transfer coefficients in perforated plate tower
6. Dynamics of liquid drops (Single drop extraction tower)
7. Studies of axial mixing characteristics in a packed bed
8. Gas-liquid mass transfer in packed tower
9. Drying characteristics of a given material

CH-3207 CHEMICAL REACTION ENGINEERING LABORATORY

Course Objectives:

* To familiarize students with main type of chemical reactors

* To analyze the experimental data to obtain the reaction rate expression (reaction order and specific reaction rate constant)

* To compare the conversion of reactants for a specific reaction in various types of reactor.

* To understand the concept of residence time distribution in reactor systems.

* To determine mass transfer coefficient of systems with chemical reaction

Course Outcomes:

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

* Determine the kinetics of a reaction in a batch reactor, CSTR, & PFR

* Determine the mass transfer coefficient (solid-liquid reacting system)

* Determine the kinetics by fractional conversion method

* Determine the temperature dependency of a reaction

* Evaluate the performance of reactors through RTD studies

* Compare the performance of single reactor with combination of reactors

List of experiments:

1. Determination of the order of a reaction using a batch reactor and analyzing the data by (a) differential method and (b) integral method

2. Determination of the activation energy of a reaction using a batch reactor

3. To determine the effect of residence time on conversion and to determine the rate constant using a CSTR

4. To determine the specific reaction rate constant of a reaction of a known order using a batch reaction.

5. To determine the order of the reaction and the rate constant using a tubular reactor

6. Determination of RTD and dispersion number in a tubular reactor using a tracer

7. Mass transfer with chemical reaction (solid-liquid system) – Determination of mass transfer coefficient

8. Axial mixing in a packed bed - Determination of RTD and the dispersion number for a packed bed using tracer

9. Langmuir adsorption isotherm - Determination of surface area of activated charcoal.

10. Performance of reactors in series: (i) A plug flow reactor followed by a CSTR and (ii) A CSTR followed by a plug flow reactor.

CH-3208 CHEMICAL PROCESS EQUIPMENT DESIGN LABORATORY

(Open book practical examination)

Course Objectives:

* The objective of the course is to design the heat exchangers and to check the suitability of the given heat exchanger and to learn how to formulate problems involving use of “new” and “old” equipment. The students will solve problems mass transfer equipments and chemical reactors

Course Outcomes:

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

* Design double pipe heat exchanger and shell and tube heat exchanger with/ without phase change

* Evaluate the suitability of given heat exchanger for the process

* Design the plate column absorption/ distillation tower

* Evaluate the performance and design of continuous/batch reactors

SYLLABUS

The following equipment are to be designed in detail:

1. Double pipe Heat Exchangers
2. Sensible heat exchangers (1-2 or 2-4),
3. Condenser and reboiler,
4. Multiple effect evaporator
5. Fractionating / Absorption column-Plate and packed columns,
6. Packed bed absorber,
7. Continuous and Batch reactors (homogeneous and heterogeneous)

CH-3209 SOFT SKILLS

Course Objectives:

* To develop skills to communicate clearly.

* To aid students in building interpersonal skills.

* To enhance team building and time management skills.

* To inculcate active listening and responding skills.

Course Outcomes:

* Make use of techniques for self-awareness and self-development.

* Apply the conceptual understanding of communication into everyday practice.

* Understand the importance of teamwork and group discussions skills.

* Develop time management and stress management.

Learning Outcomes:

* Acquisition of etiquette and skills that an engineer requires.

* Students will develop the acumen for self-awareness and self-development.

* Students will be able to communicate unmistakably.

* Students will be able to tackle real-life challenges.

Unit-I : Introduction to Soft Skills: Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

Unit-II : Goal Setting and Time Management: Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

Unit-III : Leadership and Team Management: Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

Unit-IV : Group Discussions: Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analysing Performance.

Unit-V : Job Interviews: Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, Close-Ask Q), Telephone Interviews, Types of Questions.

Reference Books:

1. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for Creating Dynamite Resumes. United States, Impact Publications, 2005.

2. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012.

3. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Education, 2001.

4. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

5. Rizvi, Ashraf M. Effective Technical Communication: India, McGraw-Hill Education. 2010.

6. Thorpe, Edgar & Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.

CH-4106 INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

* To familiarise the students with the concepts of Management.

* To relate the concepts of Management with Industrial Organisations.

* To explain the factors affecting productivity and how productivity can be increased with effective utilization of inputs in an industrial undertaking.

* To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

* An engineer with his/her fundamental knowledge of Industrial Management, will be in position to take appropriate decisions in the corporate environment. The concepts of Entrepreneurship acts as a motivating factor to launch new enterprises and translate one's dream into realty.

SYLLABUS

Basic Concepts of Management:

Management :- Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations:Introduction, Types of Business organizations: Private Sector- Individual Ownership , Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship : Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

1. Sharma,S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.

2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management(Planning for future Sustainable growth), HImalayan Publishing House, 2018.

Reference Books:

1. Aryasri , A.R., Management Science, McGraw HIll Education (India Private Limited , New Delhi 2014.

2. Sheela, P. , and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

CH-4107 SUSTAINABLE PROCESS ENGINEERING

Course Objectives:

* This subject attempts to address the gap existing between industry and institute. The student is introduced to various terminology and practices that are followed in the industry. This subject also deals with the application of core chemical engineering knowledge to the modern aspects of chemical engineering such as sustainability, green engineering, process safety and enterprise resource planning.

Course Outcomes:

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

* Explain the sustainability concepts

* Summarize waste minimization in reactors, separation processes and operations

* Identify waste in utility systems

* Identify hazards and implement safety management

* Plan enterprise resource and sustainable industries

Sustainability concepts – the concept of sustainable development, sustainability in the context of the process industries, some temporal characteristics of sustainability, the sustainable project or industry, conflicts in achieving sustainability objectives.

Cleaner production – introduction, the concept of cleaner production, the product life cycle, hierarchy of waste management, concepts and sources of waste, impacts of waste, driving forces for cleaner production, resistances to introducing cleaner production.

Industrial ecology – basic concepts, energy and materials recovery from waste streams, resource flow through the economy, transport and storage of raw materials and products, integrated site manufacture, some examples of industrial ecology initiatives.

Waste minimization in reactors – introduction, a checklist for reaction systems and reactors, chemistry of process route, impurities in reactor feed stocks, mixing of reactants, minimizing secondary reactions, recycle of unreacted feed from reactor outlet, reversible reactions, catalysis, agent materials, case studies.

Waste minimization in separation processes – classification of separation processes, sources of waste in separation processes, distillation, gas absorption, adsorption, filtration, drying, evaporation and condensation, extraction, use of extraneous materials, case studies.

Identification of waste in utility systems – introduction, fuels, fuel combustion, common fuels, environmental impacts of flue gases, theoretical flame temperature, furnaces, flare stacks, steam generation, steam use, water sources and uses, recirculated cooling water from cooling towers, sea water cooling, air cooling, refrigeration, electricity demand and supply, distribution and use of electricity, compressed air, inert gas, vacuum.

Energy conservation – introduction, energy consumption in compression of gases and pumping of liquids, pressure losses in piping and through equipment, agitation and mixing, heat recovery, energy recovery from high pressure streams, insulation, plant layout.

Materials recycling – introduction, recycling of materials in chemical processes, closed loop and open loop recycling, onsite and offsite recycling, producer and consumer waste, hierarchical approach to materials recycling, plastics recycling, glass recycling, recycling of materials from products, waste treatment option, aqueous effluent treatment and water recycling, disposal of wastes.

Waste minimization in operations – non-flow sheet emissions from a process plant, plant startup, shut down of a plant, abnormal operation, plant maintenance, cleaning of plant and equipment, fouling, transport and storage of raw materials and products, fugitive emissions, environmental risks resulting from storm water, risks in mining and extraction of materials.

Life cycle assessment – introduction, product and process applications, basic steps, goal definition, inventory analysis, example of inventory data estimation, classification, improvement analysis, some challenges and uncertainties in LCA, alternative or supplementary approaches to LCA, LCA software, LCA case studies

Planning for sustainable process industries – introduction, forecasting, scenario development, technology innovation transition to renewable feed stocks, site selection, integration of process plants and process industries, distributed manufacture, government legislation, stakeholder engagement, lifestyle implications.

Process safety management - Process safety basics, The need for process safety, Process safety for engineering disciplines, Process safety in design, Process safety in work place.

Hazard Identification and Risk Assessment – Introduction – concept hazard analysis – Preliminary process hazard analysis – critical analysis of system safety – HAZOP – FTA – Task Analysis – Task Analysis and Hazard Identification – Risk criteria – Risk assessment – Development of P&I diagrams – Hazchek list – A HAZOP study – Hazard Identification techniques – HAZID – LOPA – RAST – Whatif – Checklists – FMEA – ETA – Bow tie.

Environmental management in the chemical industry – Introduction – preamble – environmental communication – stakeholder's reaction – Impact of legislation – voluntary action by industry – standardization and certification of EMS – International aspects of environmental management.

Enterprise resource planning – Introduction to business functions and business processes, functional areas of operation, business processes, marketing and sales, supply chain management, accounting and finance, human resources, Information systems in functional areas, Development of ERP system, ERP soft wares and implementation, choosing consultants and vendors, significance and benefits of ERP software and systems.

Statutes and codes – Factories act 1948, The air (prevention and control of pollution) act 1981, The water (prevention and control of pollution) act 1974, The Environment (Protection) act 1986, Factories act 1948, ISO 9000 (QMS), ISO 14000 (EMS).

Practicals:

Practical sessions are to be conducted on training the students on some softwares such as ALOHA and DYNOCHEM.

Text books:

1. David Brennan, Sustainable Process Engineering, 2012, CRC Press. (Chapters 1 to 11, 14 and 15)

2. Introduction to process safety for undergraduates and engineers by CCPS of AIChE, Wiley, 2016.

3. Geoff Wells, Hazard Identification and Risk Assessment, Antony Rowe Ltd, UK

4. Frank Crawley, A guide to hazard identification methods, 2/e, Elsevier, 2020.

5. Ullman's encyclopaedia of industrial chemistry

6. Ellen F Monk, Bret J Wagner, Concepts in enterprise resource planning, 4/e, 2013, Course Technology. (Chapters 1 and 2)

CH-4108 INDUSTRIAL / RESEARCH INTERNSHIP EVALUATION

Evaluation of Summer Internship in the industries / Research Institutions which was carried out after 3rd year 2 semester during summer vacation.

CH-4201 PROJECT WORK, SEMINAR AND INTERNSHIP IN INDUSTRY

(Project Work/ Internship shall be carried out in the Industry/ Institutions)

Course Outcomes:

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

* Carry out literature review

* Formulate the problem involving manufacture of a chemical product/ experimentation/modeling/simulation/optimization/design

* Carry out the project involving manufacture of a chemical product/ experimentation/ modeling/simulation/optimization/design/industrial problem

* Discuss the results

* Communicate results orally to audience

* Present the detailed written report

PROFESSIONAL ELECTIVES

1. TRANSPORT PHENOMENA

Course Objectives:

* To make students understand the use of basic laws of mass, momentum and energy transport in the engineering analysis.

* Momentum transport deals with evaluation of velocity distributions in steady and unsteady laminar flow problems in simple geometries of Newtonian and non-newtonian fluids.

* Energy transport deal with the evaluation of steady/ unsteady temperature distributions in solids and in laminar flow.

* Mass transport deals with the evaluation of steady state concentration profiles with or without chemical (Homogeneous/ heterogeneous) reaction.

Course Outcomes:

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

* Identify the transport properties of solids, liquids and gases

* Formulate a mathematical representation of flow / heat / mass transfer phenomena

* Solve steady state flow/heat/mass transfer problems for simple geometries analytically

* Solve unsteady flow/ heat problems for simple geometries

SYLLABUS

PART-A

Momentum Transport: Viscosity and the mechanism of momentum transport- i). Newton's law of viscosity, ii). Non-Newtonian fluids and iii). pressure and temperature dependence of viscosity,

Velocity Distributions in Laminar Flow: i). Shell momentum balances boundary conditions, ii). flow of a falling film, iii). flow through a circular tube and iv). flow through an annulus,

The Equations of Change for Isothermal Systems: i). The equations of continuity, motion and mechanical energy in rectangular and curvilinear coordinates, ii). use of the equations of change to set up steady flow problems and iii). dimensional analysis of the equations of change,

Velocity Distributions with more than one independent variable and unsteady viscous flow,

PART-B

Energy Transport: Thermal conductivity and the mechanism of energy transport- i). Fourier's law of heat conduction and ii). temperature and pressure dependence of thermal conductivity in gases and liquids,

Temperature Distributions in Solids and in Laminar Flow: i) Shell energy balances-boundary conditions, ii). heat conduction with an electrical heat source, iii). heat conduction with a viscous heat source, iv). heat conduction through composite walls, v). forced convection and vi). free convection,

The Equations of Change for Non-Isothermal Systems: i). The equation of energy in rectangular and curvilinear coordinates, ii). the equations of motion for forced and free convection in non-isothermal flow, iii). use of the equations of change to set up steady state heat transfer problems and iv). dimensional analysis of the equations of change,

Temperature Distribution with More Than One Independent Variable: Unsteady state heat conduction in solids,

PART-C

Mass Transport: Diffusivity and mechanism of mass transport- i). Definitions of concentrations, velocities and mass fluxes, ii). Fick's law of diffusion and iii). temperature and pressure dependence of mass diffusivity,

Concentration Distribution in solids and in laminar flow: i). Shell mass balances – boundary conditions, ii). diffusion through a stagnant gas film, iii). diffusion with heterogeneous chemical reaction, iv). diffusion with homogeneous chemical reaction and v). diffusion into a falling liquid film,

The Equations of Change for Multi-Component Systems: i). The equations of continuity for a binary mixture, ii). the equations of continuity of A in curvilinear

coordinates and iii). dimensional analysis of the equations of change for a binary isothermal fluid mixture,

Text Book:

'Transport Phenomena' by R. Byron Bird, W.E. Steward and Edwin N. Lightfoot, John Wiley& Sons Inc., New York

Reference Books:

1. Transport phenomena' by Robert S. Brodkey & Haryr C. Hershey, McGraw Hills Company, New York

2. Transport Phenomena-for engineers' byLouis Theodore, International Book Compnay, London

3. 'Transport Phenomena' by W.J.Book and K.M.K.Multzall, JW&Sons Ltd.

4. 'Fundamentals of Momentum, Heat and Mass Transfer' by Mames R Welty, Charlese Wicks and Robert E Wilson, J W & Sons Inc., New York

5. Fluid Dynamics and Heat Transfer' by James G. Knudsen and Donald L.Katz., McGraw Hills Company Inc., New York

2. FUEL CELL TECHNOLOGY

Course Objectives:

* To provide deeper knowledge, a wider scope and improved understanding of theory, analysis, performance, design and the operational principles of various fuel cell components and systems.

* To provide the design and analysis emphasis on the thermodynamics and heat transfer for all thermal systems of a fuel cell stack.

Course Outcomes:

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

* Understand fuel cell fundamentals.

* Analyze the performance of a fuel cell and stack.

* Demonstrate the operation of fuel cell stack and fuel cell system

* Apply the modeling techniques for fuel cell systems

SYLLABUS

Introduction – fuel cell; brief history of fuel cells, types of fuel cells and fuel cell applications.

Thermodynamics and Electrochemical kinetics – Engineering thermodynamics, conversion efficiencies of heat engines and fuel cells, chemical reactions, chemical thermodynamics and electrochemical kinetics.

Fuel cell components and their impact on performance – General design features, fuel cell performance: the MEA and the current/voltage curve, MEA components and the fuel cell stack.

Stack design – Sizing of a fuel cell stack, stack configuration, uniform distribution of reactants inside each cell, heat removal from a fuel stack and stack clamping.

Fuel cell modeling – Theory and governing equations, modeling domains and modeling examples.

Fuel cell system design – Hydrogen-air system, fuel cell systems with fuel processor, electrical subsystems and system efficiency.

Fuel cell applications – Transportation applications, stationary power, backup power and fuel cells for small portable power.

Text Books:

1. For chapters 1 to 3: Fuel Cell Technology Hand Book, Edited by Gregor Hoogers, CRC Press.

2. For Chapters 4 to 7: PEM Fuel Cells: Theory and practice By Frano, Elsevier Academic Press

Reference Books:

1. Fuel cells principles and applications by B.Viswanathan and M. Aulice Scibioh, Universal Press. (India) Private Limited, Hyderabad.

2. Fuel Cell Systems Explained, second edition, by James Larminie and Andrew Dicks, John Wiley & Sons Ltd.

3. PETROCHEMICALS

Course Objectives:

To make a thorough understanding of the availability of petroleum resources, technical and financial constrains of all the elementary problems. To know the development of petrochemical industries and methodolically furnishes the conversion of petroleum feedstock's to chemical and intermediates.

Course Outcome:

* Able to know Petrochemical industry-Feedstock, various important Chemicals produced from ethylene and C_3, C_4 and higher carbon atoms.

* Able to know the structure of Polymer, methods of polymerization, high pressure polyethylene (LDPE), low pressure polyethylene (HDPE),

* Able to know Petroleum aromatics, synthetic fibers, Synthetic rubber, Plastics and Synthetic detergents.

* Able to understand all the production processes and will get an awareness on accidents that are occurring in industries during handling, storage, and manufacturing of chemicals, remedial measures to arrest the accidents immediately.

SYLLABUS

Petrochemical industry-Feedstocks: Petrochemical industry in India, feed stocks for petrochemicals.

Chemicals from ethylene: Vinyl chloride monomer, vinylacetate monomer, ethylene oxide, ethylene glycol, acetaldehyde.

Chemicals from C_3,C_4 and higher carbon atoms: Isopropylalcohol, acrylonitrile, acrylic acid, phenol, bisphenol-A, iso and n-butanol, methyltertbutylether, methacrylic acid, malic anhydride.

Polymers of olefins: Polymer structure, methods of polymerization, high pressure polyethylene (LDPE), low pressure polyethylene (HDPE), polypropylene, polyvinylchloride, polystyrene.

Petroleum aromatics: Benzoic acid, caprolactum, terephthalic acid, phthalic anhydride,

Synthetic fibres: Production techniques of synthetic fibres, production of polyester, nylon-6,6, nylon-6, acrylic fibers.

Synthetic rubber: Styrene butadiene rubber (SBR), butyl rubber, synthesis of polyurethane.

Plastics: Phenol formaldehyde resins, urea formaldehyde resins, polycarbonates.

Synthetic detergents: Classification of detergents, general manufacture of sulphonates, keryl benzene sulphonate (Surf).

Text Book:

'A Text on Petrochemicals' by B.K.Bhaskara Rao, 3rd Edition, Khanna Publishers, NewDelhi.

Reference Text Books:

1. 'Petrochemical processes', Vol.2, 2nd edition, by A.Chanvel and G. Lefebvre, Gulf publishing company.

2. 'Shreve's chemical process industries', 5th edition, by George T. Austin, Mc Graw Hill Publishers

4. POLYMER TECHNOLOGY

Course Objectives:

* To make a thorough understanding of the classification, characterization of the polymers and their structure and its applications

* To introduce the manufacturing methods of different polymers and different additives, blends and composites used in the process

Course Outcomes:

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

* Classify polymers and determine molecular weight of the polymer

* Understand thermodynamics of polymer structures

* Select polymerization reactor for a polymer product.

* Characterize polymers.

* State polymer additives, blends and composites

* Understand polymer rheology

* Identify suitable polymer processing methods

SYLLABUS

Introductory Concepts and Fundamentals: Definitions and concepts of plastics and polymers, comer, co-monomer, mesomer, co-polymer, functionality, visco-elasticity, Classification of polymers, methods of determining molecular weights of polymers-

(i) Methods based on colligative properties

(ii) Sedimentation velocity method

(iii) Sedimentation equilibrium method

(iv) Gel-chromatography method

(v) Light scattering analysis method

(vi) End-group analysis method Natural polymers- brief study of rubber, shellac, rosin, cellulose, proteins, Lignin's,

Chemistry of Polymerization: Elementary concepts of addition polymerization, condensation polymerization and co-polymerization, glass transition temperature of polymers, methods of determining Tg, degradation of polymers due to mechanical, hydrolytic, thermal and backbone effects,

Relation of the mechanical, thermal, electrical, physical and chemical properties with the structure of the polymer,

Methods of Polymerization: Mass, solution, emulsion and suspension, role of the initiators, catalysts, inhibitors, solvents, fillers, reinforcing agents, stabilizers, plasticizers, lubricants, blowing agents, coupling agents, flame retardants, photo-degradants and bio-degradable on polymerization,

Methods of Manufacture, Properties and Uses of the following Addition Products;

Polyethylene (LDPE and HDPE) , polypropylene, PVC and its copolymers, Polystyrene and its copolymers, acetals and PTFE (polytetraflouroethylene),

Methods of Manufacture, Properties and uses of the following Condensation Products: (i)Polyesters-PMMA, PET and ALKYO, (ii) PF-, UF- and MF-resins (iii) epoxy resins, polyurethanes and silicones,

Description of the following Processing Methods: (with the principles involved and equipments used) Mixing and compounding, extrusion, calendaring, laminating, moulding-compression, transfer, injection and blow moulding.

Text Books:

1. 'Plastic Materials' by J.A.Brydson, Newnes-Butterworths (London) 1989

2. 'Textbook of Polymer Science', Billymeyer, F.W.Jr., 3rd edition, John Wiley & Sons,

Reference Books:

1. 'Introduction to Plastics' by J.H.Briston and C.C. Gosselin, Newnes, London

2. 'Polymeric Materials' by C.C.Winding and G.D.Hiatt, McGraw-Hill Publishers

5. PROCESS MODELING & SIMULATION

Course Objectives:

* To introduce different types of models along with examples related to chemical engineering

* To instruct how to develop empirical models using different tools and the use of numerical methods for solution of Non- Linear Algebraic equations

* To disseminate the use of different numerical techniques for carrying out numerical integration and differentiation.

* To impart knowledge on modelling of various equipment and their simulation using different numerical techniques.

* To guide selection of the solution method based on the computational requirements of various solution options.

* To elucidate process simulation using modular and equation based solving approaches.

Course Outcomes:

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

* Classify different types of mathematical models

* Develop mathematical model for the given chemical engineering problem from basic engineering principles.

* Identify the appropriate numerical method for solving a given model.

* Solve ODEs and PDEs using different numerical methods.

* Simulate binary distillation column, gravity flow tank, batch reactor, Non-isothermal CSTR, and counter-current heat exchanger.

* Compare and contrast modular approaches with equation oriented approach

SYLLABUS

Mathematical Models for Chemical Engineering Systems: classification of mathematical models- steady state vs dynamic models, lumped vs distributed parameter models, deterministic vs stochastic models.

Examples of Mathematical Models: Two heated tanks, batch reactor, constant volume CSTRs, non-isothermal CSTR, reactor with mass transfer, ideal binary distillation column, batch distillation with holdup.

Empirical Model Building- method of least squares, linear, polynomial and multiple regression, non-Linear regression.

Solution of Non- Linear Algebraic Equations- bisection, false position, Quasi Newton and Newton- Raphson methods.

Numerical Integration- Trapezoidal rule, Simpson's rule and Newton–Cotes formula.

Numerical Solution of Differential Equations- Euler's method, Runge-Kutta methods, predictor corrector methods.

Numerical Solution of Partial Differential Equations- elliptic, parabolic and hyperbolic equations, finite difference methods, Leibman's method, Crank Nicholson method. Applications to steady state and Unsteady state heat conduction and temperature distribution problems.

Process Simulation Examples: VLE dew point and bubble point calculations, binary distillation column, gravity flow tank, batch reactor, Non-isothermal CSTR, countercurrent heat exchanger.

Process Simulation using Modular and Equation Based Solving Approaches: Developing a simulation model, a simple flow sheet, Sequential modular approach, Simultaneous modular approach, Equation solving approach.

Textbooks:

1. Process modelling, Simulation and Control for Chemical Engineers, 2nd ed., W. L. Luyben, McGraw-Hill, New York, 1990.

2. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995.

Reference Books:

1. Numerical Methods for Engineers and Scientists, S.S. Rao

2. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010

3. Process Modelling and Simulation, Amiya K. Jana, 2012.

6. PETROLEUM REFINERY ENGINEERING

Course Objectives:

* To introduce the basics of refinery engineering subject for petroleum specialization students to gain knowledge of the overall refinery operations, refinery products and its test methods.

* To learn various primary and secondary cracking process available to produce normal and value added products.

* Further, to learn the treatment process available to remove the impurities in the crude and finished products and its test methods for quality check.

Course Outcomes:

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

* Compare various theories on origin and formation of petroleum, to explain and summarize the composition of crude oil, to prepare a report on the world wide scenario of reserves and deposits and the Indian petroleum refining industry scenario.

* Describe and summarize various petroleum products, to know various analytical tests available for estimating various physico chemical properties and classify the crude into different classes.

* Classify the crude processing methods and describe the treatment process i.e. Desalting and Dehydration and infer the preliminary process i.e. Atmospheric Distillation and Vacuum Distillation Units.

* Summarize and infer various secondary cracking process to produce value added products and to design the equipment in the refining industry.

SYLLABUS

Origin and formation of Petroleum. Reserves and deposits of the world, Composition of crudes, Refinery introduction and Indian petroleum refining industry scenario. Refinery products and test methods, Evaluation of crudes, Crude pretreatment-Dehydration and desalting, Pipe still heater. Atmospheric and Vacuum distillation of crude oil.

Thermal Conversion Process- Vis Breaking, Delayed Coking. Catalytic Conversion Process- Fluid Catalytic Cracking, Hydrocracking, Hydrotreating, Alkylation, Isomerization, Polymerization and Reforming.

Lube Oil Process – Solvent deasphalting, solvent Extraction, Solvent Dewaxing and Hydro finishing.

Treatment of kerosene, additives, blending of gasoline, Asphalt and air blown asphalt.

Textbooks:

1. Petroleum Refining Technology by Dr. Ram Prasad

2. Modern Petroleum Refinery Engineering by B K Bhaskar Rao

3. Gary, J.H., Handwerk, G.E. and Kaiser, M.J. (2007) Petroleum Refining: Technology and Economics. 5th Edition, CRC Press, Boca Raton, 488 p.

4. Petroleum Refining. Vol. 3 Conversion Processes, Pierre Leprince (Editor).

7. MULTI COMPONENT SEPARATION PROCESSES

Course Objectives:

* Provide an introduction to design methods of equilibrium and non-equilibrium multi-component mass transport processes

* The student will learn how to solve different shortcut and rigorous models

* The student will make use of conceptual design methods in designing and troubleshooting industrial mass transport processes

Course Outcomes:

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

* Predict multi component VLE data from the model constants of constituent binaries

* Determine high pressure equilibria

* Understand flash vapourization and multicomponent differential distillation

* Interpret the design considerations of fractionating process

* Design of distillation column for azeotropic and extractive distillation

* Differentiate tray design and operation versus packing design and operation

SYLLABUS

Multi Component Vapor –Liquid Equilibria: Ideal mixtures at low pressures, non-ideal mixtures, activity coefficient models - Wilson, NRTL, UNIQUAC and UNIFAC equations, evaluation of model constants from binary experimental data, prediction of multicomponenet VLE from the model constants of the constituent binaries,

High Pressure Equilibria: Vaporization constants, K, Thermodynamic method for K, graphical charts, chao-Seader correlation,

Equilibrium and Simple Distillation: Multicomponent equilibrium, flash vaporization(EFV), multicomponent differential distillation,

Design Considerations in Fractionating Process: Quantitative relationships, temary and multicomponent system fractionation, key fractionation concepts, selecton of key components, column pressure, material balance, rigorous and approximate minimum reflux calculations, recommended short-cut methods for minimum reflux minimum plates at total reflux, FUG methods, Smith Brinkley method,

Multicomponent Fractionation Rigorous Design Procedures: Sorel method, Lewi Metheson method, Thiele-Geddes method and its versions in distillation column design, techniques of separating azeotropic and close

boiling mixtures by fractional distillation, azeotropic and extractive distillation, selection of solvents, design considerations, pseudo binary methods, solvent recovery,

Tray Design and Operation: The common tray types, tray capacity limits, tray hydraulics parameters, flow regies on trays, column sizing, tray efficiency, fundamentals, tray efficiency prediction,

Packing Design and Operation: Packing types, packing hydraulics, comparing packings and trays, packing efficiency and scale-up.

Text Books:

1. 'Distillation' by M.Van Winkle, McGraw Hill Book Company
2. 'Phase Equilibria in Chemical Engineering' by S.M.Wales, Butterworth publishers, 1985
3. 'Distillation Design' by Henery Z Kister, McGraw Hill Book Company

8. CHEMICAL ENGINEERING MATHEMATICS

Course Objectives:

* To learn various computational techniques for analyzing and solving chemical engineering problems.

Course Outcomes:

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

* Understand the fundamental mathematics and to solve problems of algebraic and differential equations, simultaneous equations and partial differential equations.

* Evaluate problem solving strategies to procedural algorithms and to write program structures.

* Solve engineering problems using computational techniques

SYLLABUS

Mathematical Formulation of the Physical Problems: i). Application of the law of conservation of mass, salt accumulation in stirred tank, starting an equilibrium still, solvent extraction in N stages, diffusion with chemical reaction and ii). application of the law of conservation of energy, radial heat transfer through a cylindrical conductor, heating a closed kettle, flow of heat from fin,

Analytical (Explicit) Solution of Ordinary Differential Equations Encountered in Chemical Engineering Problems: i). First order differential equations, method of separation of variables, equations solved by integration factors, certain examples involving mass and energy balances and reaction kinetics and ii). second order differential equations, non-linear equations, linear equations, simultaneous diffusion and chemical reaction in a tubular reactor, continuous hydrolysis of tallow in a spray column,

Partial Differential Equations: i). Formulation of partial differential equations, unsteady-state heat conduction in one dimension, mass transfer with axial symmetry, continuity equation, ii). boundary conditions- function specified, derivative specified and mixed conditions and iii). particular solutions of partial differential equation- compounding the independent variable into one variable, superposition of solutions, the method of images and particular solution suggested by the boundary conditions,

Finite Differences: i). The difference operator, properties of the difference operator, difference tables, other difference operators, ii). linear finite difference equation, complementary solution, particular solution, simultaneous linear difference equations and iii). non-linear finite difference equations, analytical solutions,

Solutions for the following Type of Problems by Finite Difference Method: a). Calculation of the number of plates required for an absorption column, b). calculation of the number of theoretical plates required for distillation column and c). calculation of number of stages required for a counter current extraction and leaching operation,

Application of Statistical Methods: i). Propagation of errors of experimental data, ii). parameter estimation of algebraic equations encountered in heat and mass transfer, kinetics and thermodynamics by method of averages, linear least squares and weighted linear least squares methods and iii). design of experiments - factorial and fractional factorial methods.

Text Book:

'Mathematical Methods in Chemical Engineering' by V.G.Jenson and G.V.Jeffreys, Academic Press, London

Reference Books:

1. 'Applied Mathematics in Chemical Engineering' by Harold S. Mickley, Thomas S. Sherwood and Charles E. Reed, Tata McGraw Hill Publications.
2. 'Introductory Methods of Numerical Analysis' By S.S. Sastry, Prentice Hall of India Private Limited, New Delhi.

9. FERTILIZER TECHNOLOGY

Course Objectives:

* To introduce various nutrients and their role in growth of a plant

* To introduce different types of the nitrogenous, phosphatic, potassic and compound fertilizers

* To introduce different fertilizer production methods

Course Outcomes:

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

* understand different raw material availability

* Explain the beneficiation of rock phosphate

* Discuss the production of all types of fertilizers

* Formulate different fertilizer mixtures

SYLLABUS

Details about Indigenous Fertilizer Production – raw materials, details of various nutrients with their importance, sources of nitrogen and hydrogen, steam reforming of hydrocarbons, partial oxidation of fuel cells with gas purification including high and low temperature shift conversion, carbondioxide removal processes and methanation.

Coal Gasification, ammonia synthesis, thermodynamic principles associated with ammonia synthesis, ammonia reactors, nitric acid and sulfuric acid.

Urea – total recycle and stripping processes, process details of ammonium sulfate, ammonium chloride, ammonium nitrate, calcium ammonium nitrate.

Phosphate Rock – availability and beneficiation methods for upgrading, bone meal, basic slag, single super phosphate, triple super phosphate, phosphoric acid by wet process and furnace process, AMI process with hydrochloric acid, complex fertilizers like mono and di-ammonium phosphates, urea ammonium phosphate.

Text Book:

'Hand Book of Fertilizers' published by fertilizer Association of India, New Delhi

Reference Books:

1. 'Chemistry and Technology of Fertilizers' by V. Sauchelli, Reinhold Publications.

2. 'Fertilizers Manual, a UNIDO Publication from International Fertilizer Development Centre, Alabama, USA.

3. 'Chemical Technology-II' published by IIT, Madras.

10. COMPUTER AIDED DESIGN

Course Objectives:

* To revise the basic concepts in Fluid Mechanics, Heat Transfer, Mass Transfer and Chemical Reaction Engineering and apply the numerical methods with the aid of computer in designing such systems.

Course Outcomes:

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

* Elaborate the need of computer aided design and advantages of simulation

* Design the size of the pipe for a given pressure drop for Newtonian and non-newtonian fluids

* Evaluate pressure drop in compressible fluid flow, pipe line networks and two phase flow

* Develop the rating and design calculations in heat exchangers, distillation columns, extraction cascades, plate/packed bed absorbers and isothermal flash.

* Design ideal reactors, packed bed and fluidized bed reactors

* Estimate rate of extent of reaction vector for simultaneous reactions

SYLLABUS

CAD of Fluid Flow System:

Flow of Newtonian fluids in pipes

Pressure drop in compressible flow

Flow of Non-Newtonian fluids in pipes

Pipe network calculations

Two phase flow system,

CAD of Heat Transfer Equipment: Shell and tube exchangers without phase change, Condensers, Reboilers, Furnaces,

CAD of Mass Transfer Equipment: Distillation, Gas absorption ,Liquid extraction,

CAD of Chemical Reactors: Chemical reaction equilibrium ,Analysis of rate data, Ideal reactor models, Non-ideality in chemical reaction, Performance analysis using residence time distribution, Temperature effects in homogeneous reactors, Heterogeneous systems, Fluidized bed reactors.

Text Book:

Chemical Process Computations by Raghu Raman. Elsevier Scientific Publishers, London, 1987

Reference Books:

1. Fundamentals and Modelling of Separation process by C D Holland, rentice Hall Inc. New Jercey, 1975

2. Catalytic Reactor Design by Orhan, Tarhan, Mc Graw Hill, 1983

3. Chemical Engineering, Vol 6 by Sinnot, Pergamon Press, 1993

11. PROCESS ENGINEERING & ECONOMICS

Course Objectives:

* To introduce types of interests, annuity, perpetuity, bond, debenture

* To introduce depreciation and cost accounting methods

* To introduce cash flow tree diagram, methods of cost estimation.

* To introduce profitability, profitability evaluation

* To introduce optimization in industries

* To introduce economic balance of various operations.

Course Outcomes:

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

* Determine costs involved in process plants.

* Estimate depreciation costs and various ratios to tell about financial status of the company

* Perform economic analysis and optimum design of the processes

* Evaluate project profitability.

SYLLABUS

Value of Money - Equivalence: Value of money, equations for economic studies, equivalence, types of interest- discrete and continuous, annuities - relation between ordinary annuity and the periodic payments, continuous cash flow and interest compounding, present worth of an annuity, perpetuities and capitalized costs, bonds and debentures, value of a bond and yield rate,

Depreciation: Types and various methods of calculating depreciations, depreciation accounting,

Cost Accounting: Basic relationship in accounting, balance sheet and income statement, various ratios to study the balance sheet and income statements,

Cost Estimation: Cash flow for industrial operations, factors affecting investments and production costs, estimation of capital investment, cost indices, cost factors in capital investment, methods of estimating capital investment, estimation of total product cost- manufacturing costs and general expenses,

Profitability: Alternate investments and replacements. mathematical methods for profitability evaluation, economic production charts for plants operating below 100%, above 100% and under dumping conditions, general procedure for determining optimum conditions, break even chart for production schedule and its significance for optimum analysis,

Economic Balance in fluid flow, heat transfer and mass transfer operations; optimum economic pipe diameter in fluid dynamics, optimum flow rate of cooling water in condenser in heat transfer and optimum reflux ratio in distillation operation,

Economic Balance in cyclic operations and semi continuous cyclic operations, economic balance in yield and recovery, economic balance in chemical reactors, batch and flow reactors.

Text Books

'Plant Design and Economics for Engineers' by Max S. Peters and K.D.Timmerhans, McGraw Hill Book Company,

'Process Engineering Economics' by Herbest E. Schweyer, McGraw Hill Book Company.

12. PROCESS OPTIMIZATION

Course Objectives:

* Optimization of Chemical Process is an important of subject for Chemical Engineers. It deals with various optimization techniques in reducing cost of production ,energy consumption, maximum throughput and minimum labour cost etc. Onstudying the course one can understand how to write a model of the process optimize the process using the model

Course Outcomes:

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

* Understand the definition of Optimization and how to write an Objective function

* Understand various types of Objective functions like Concave and Convex functions and its properties

* Study the Optimization of uni & multi dimensional search problems

* Solve the Optimization problems by Linear and Non-Linear Programming methods

SYLLABUS

Definition of optimization Applications of optimization optimal insulation thickness Requirements for an optimization technique, Writing an objective function Production schedule ,material balance requirements , six steps of solving an optimization problem.

Basic concepts of optimization continuous and discontinuous , unimodal and multi modal functions concave and convex functions, Finding the optimal point, definition of maximum, minimum and saddle points with examples.

Unconstrained unidimensional search , Newton method Quasi Newton method and Secant method, Speed of iterations linear ,order p and super linear, Quadratic interpolation, cubic interpolation, Region elimination method, Fabonacci and Golden section method.

Multivariable unconstrained optimization ,direct methods Powell method,Conjugate searchdirection, Gradient and conjugate Gradient, Fletcher Reeves method , Positive definite of Hessian matrix Marquadt method.

Linear programming ,definition , solving the refinery schedule problem by linear programming method using graph, Simplex method and definition.

Non linear programming , Lagrange multiplier method, Iterative linearization and Quadratic programming method, Necessary and sufficient condition for a minimum value ,Kuhn-tucker conditions.

Text Books:

1. Optimization of Chemical Process by Edgar and Himmelblau, 2nd edition, Mc GrawHill Publications.

2. Optimization Theory and Applications by S.S. Rao, 2nd Edition, Wiley Eastern Limited.

3. Formulation and optimization of Mathematical Models by C.L.Smith, R.W. Pike and P.W.Mur.

13. RESERVOIR ENGINEERING

Course Objectives:

* To know the fundamental concepts of reservoir engineering, basic properties of reservoir rocks, various types of reservoirs and driving mechanisms for the production of Oil and gas from an oil reservoir.

Course Outcomes:

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

* Identify the type of oil reservoirs by knowing the characteristics and mechanisms.

* Predict the reservoir performance by knowing the past performance history of the oil reservoir.

SYLLABUS

Fundamental Concepts of Reservoir Engineering: Porosity, fluid saturation, permeability, flow through layered beds, flow through series beds, Klinkenberg effect, effective permeability data, phase behavior.

Oil Reservoirs: Reservoir driving mechanisms, basic equation and tools, volatile oil reservoirs, identification of volatile oil reservoirs, ultimate recovery, predicting reservoirs behavior, performance, mechanics of reservoir performance, prediction procedure, limitations of predictions, relating reservoir performance to time, factors affecting ultimate recovery, analysis of gas oil ratio history.

Depletion Drive Reservoirs: Producing characteristics and methods of identification, detailed procedure for predicting reservoir performance, limitations of predictions, factors affecting ultimate recovery.

Water Drive Reservoirs: Effect of free gas saturation on recovery, predicting reservoirs performance, calculating water influx, use of the unsteady state equation in predicting reservoir performance, validity of performance prediction, limitations in predicting reservoir performance, the material balance equation as a straight line.

Gravity Drainage Reservoirs: Permeability in the direction dip, dip of the reservoir, reservoir producing rates, oil viscosity, relative permeability characteristics, fundamental recovery process, predicting reservoir performance, apparent relative permeability, oil saturation method.

Combination of Drive Reservoirs: Index of drives, equations used, material balance equations, instantaneous gas- oil ratio equation.

Pressure Maintenance: Pressure maintenance by gas injection, condensing gas drive, predicting performance by gas injected gas drive index, pressure maintenance by water injection, predicting performance by water injection, index of injected water drive, control of the gas cap, typical water injection pressure maintenance operations.

Improving Oil Recovery: Improving oil recovery by fluid immiscible gas–water, miscible fluid injection thermal oil recovery, predicting recovery from fluid injection products, Stiles's method of water flood prediction, derivation of water cut and recovery equations, frontal advance techniques for prediction result of either water or gas injection, well arrangements, peripheral water flooding, predicting behavior of peripheral water floods, special consideration involved in water flooding, water flood case history, predicting the results of water flooding.

Text Book:

'Reservoir Engineering Manual' – 2nd Edition by Frank W. Cole, Gulf Publishing Company, Houstan, Texas, 1969.

14. PAPER TECHNOLOGY

Course Objectives:

* To understand the growth prospects of Indian paper mills, history of paper industry, different types, composition and uses of paper, raw materials for paper making, preparation of raw materials, classification of fibers, recovery of cooking chemicals from spent cooking liquors, Pulping processes, manufacture of paper and Testing of different properties of pulp and paper and the types of pollutants from paper industry and their treatment.

Course Outcomes:

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

* Understand the history of development of paper industry in India and Importance of paper industry, historical background of paper making.

* Explain growth prospects of Indian Paper mills.

* Design the equipment used for the manufacture of paper.

* Explain how to reduce the paper wastes

* Maximize the production rate and recovery of useful chemicals.

SYLLABUS

History: Importance of paper industry, historical background of paper making, development of paper industry in India.

Different types and uses of paper: Different types and uses of papers and paper boards, composition, method of making different types of papers and boards.

Raw materials for paper making: Classification of fibres, characteristics and composition of some important vegetable fibers (hard woods, softwoods, bagasse, straws, rags and paper stock)

Preparation of raw materials: Wood preparation – pulp wood measurement, barking, chipping, screening and conveying of chips).

Pulping processes: Mechanical pulping, alkaline pulping (Soda and Kraft), sulfite pulping, semi-chemical pulping, recovery of cooking chemicals from spent cooking liquors.

Pulp bleaching: Bleaching agents, bleaching methods – single stage and multi stage bleaching, Stock preparation: Beating and refining, sizing and loading (filling).

Manufacture of paper: Paper machines (Fourdrinier and Cylinder), making of paper – forming section, press section, dryer section, calendaring section.

Testing of different properties of pulp and paper: Testing and evaluation of pulp, various properties of pulp and paper and their testing.

Text Books:

1. 'Handbook of Pulp and Paper Technology' by Kenneth W.Britt, Vols.I&II

2. 'Modern Pulp and Paper Making' edited by John B.Calkin

3. 'Pulp and Paper: Science and Technology - Vols.I&II' by E.Libby, McGraw Hill Books Co.

4. 'Pulp and Paper Manufacture- Vols. I & II' by R.C.McDonald & Others, McGraw Hill Books Company.

15. COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING

Course Objectives:

The objective of this course is to provide student with

* a sufficient background regarding the applications of computers in Chemical Engineering problems.

* The Knowledge of numerical integration, numerical differentiation, function approximations, solution of linear equations using matrix methods, solution of ordinary differential equations, initial value problems, boundary value problems and solution of partial differential equations by solving number of problems.

Course Outcome:

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

* Learn the applications of computers in solving chemical Engineering problems

* Solve /write programs for Chemical Engineering problems

SYLLABUS

Roots of Algebraic and Transcendental Equations: Iteration methods, Regula-Falsi method, Newton Rapson method, roots of simultaneous sets of transcendental and algebraic equations, System of linear equations and their solution by different techniques, numerical differential and integration, regression analysis, least squares and orthogonal polynomial approximation, Numerical solution of ordinary differential equations, Numerical solution of partial differential equations (simple case studies), Application of the above Techniques to Problems of Interest in Chemical Engineering.

Text Book:

'Digital computation for chemical engineers' by Leaon Lapidus, McGraw Hill Book Company

Reference Books:

1. 'Applied Numerical Methods' by Camehanet, McGraw Hill Book Co.

2. 'Applied Numerical Methods with Personal Computers, by Constantinides, McGraw Hill Book Co, New York

OPEN ELECTIVES

1. CORROSION ENGINEERING

Course Objectives:

* Basic aspects of electrochemistry relevant to corrosion phenomena,

* Importance and forms of corrosion.

* Knowledge on corrosion rate expressions and measurement techniques.

* Basic knowledge on remedial measures for corrosion.

Course Outcomes:

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

* Identify various forms of corrosion.

* Determine corrosion rates for metals from their polarization curves

* Analyze corrosion rate characteristics from electrochemical impedance spectroscopy

* Select suitable corrosion resistant coatings, oxide layers for various applications

SYLLABUS

Introduction and Scope: Corrosion definition, wet and dry corrosion, mechanism, electro-chemical principles and aspects of corrosion, Faradays laws, resistance, specific resistance, conductance, specific conductance, transport numbers, ionic mobility, corrosion rate expressions, calculation of corrosion rates, thermodynamic aspects of corrosion, equilibrium potential, Nernst equation for electrode potential, EMF series, over voltage, application of Nernst equation to corrosion reactions,

Polarisation and Corrosion Potentials: References electrodes for corrosion measurements, types of polarisation, concentration, activation and resistance polarizations, Tafel constant, Evans diagrams, anodic control, cathodic control, mixed control, Pourbaix-diagram for Fe-H_2O system,

Various forms of Corrosion: Uniform attack, galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, selective leaching (dezincification), cavitation damage, fretting corrosion, erosion corrosion, and stress corrosion and remedial measures,

Prevention Techniques: Modification of the material by alloying, appropriate heat treatment, chemical and mechanical methods of surface treatment, metallic, non-metallic linings, inhibitors, passivity, Cathodic protection and anodic protection.

Text Books:

1. 'Corrosion Engineering' by Mars G. Fontana, Tata McGraw Hill Publishing Company, New Delhi

2. 'Corosion and Corrosion Control' by H.H.Uhllg, John Wiley & Sons Inc., America

Reference Books:

1. 'Electrochemistry' by Samuel Glasstone, Litton Educational Publishing Company

2. 'Electrochemistry, Principles & Applications' by Edmond C.Potter, Cleaver Hume Press Limited.

2. WHITEWARE AND HEAVY CLAYWARE

Course Objectives:

* The applications for advanced ceramics have received major attention in recent years, particularly for use as parts in a future ceramic heat engine.

* The properties like corrosion resistance, chemical inertness, thermal shock resistance and other properties made both traditional and advanced ceramics highly attractive in a large number of applications.

Course Outcomes:

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

* Classify whiteware products

* Identify raw materials for heavy clayware and products of heavy clayware

* Importance of fine ceramics.

* How to use resources more efficiently.

* Demonstrate the tests and quality control measures of clay ware products

SYLLABUS

Classification of Whiteware Products: Body formulation and properties, tableware, earthenware talc bodies, vitreous bodies, high alumina bodies, porcelain, bone china, sanitary ware, stoneware, majolica, terracotta, art ware, physical properties of mixtures, role of water.

Whiteware: Classification, body composition, white wares at home, construction, electrical appliances, industrial uses, manufacturing and properties.

Heavy Clayware: Raw materials, methods of winning and handling, classification of building materials, manufacture of building bricks, hollow bricks and other bricks, roof tiles, paving tiles, sewer pipes.

Fine Ceramics: Packing of two component system, porosity, effect of grain size, unfired porosity, experimental verifications, wet to dry contraction, unfired strength, permeability and casting rate, dry to fired contraction.

Tests and Quality Control: IS inspection, LOI, plasticity, strength, MOR, thermal shock resistance, abrasion resistance, porosity, acid and alkali resistance, chipping resistance, chemical analysis, electrical and thermal conductivity.

Text Books:

1. 'Pottery Science: Materials, Processes and Products' by Allen Dinsdale, Ellis Horwood Ltd., New York,

2. 'Ceramic White Ware' by Sudhir Sen, Oxford& IBH Publishing Co., New Delhi

Reference Book:

'Industrial Ceramics' by F. Singer and S. Singer, Oxford & IBH Publishing Company,

3. CERAMIC RAW MATERIALS

Course Objectives:

* To procure knowledge about the earth

* To gain knowledge regarding the rocks which are most useful ores.

* To know about the physical and optical properties of the minerals and ores

* To gain acquaintance with formation of different raw materials.

* To collect information about the different types of clays

* To put on the knowledge regarding other raw materials used in the ceramics

* To get information regarding the distribution of the deposits

Course Outcomes:

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

* Identify the sources/ availability of raw materials for ceramics

* Examine different clays as raw materials for various ceramic products

* Explain the behavior of silicates as ceramic raw materials

* Acquire knowledge about accessory ceramic raw materials.

SYLLABUS

General Geology and Mineralogy: Formation of rocks, their characteristics, classification into igneous, sedimentary and metamorphic groups, formation of mineral deposits, physical and mineral characteristics of minerals – composition, color, streak, luster, fracture, cleavage, hardness, density and tenacity, elements of optical mineralogy.

Clays: Clay minerals, clay structure – kaolinite and montmorillonite groups, geology of clay deposits, their classification - china clay, ball clay, fire clay, building clay etc., beneficiation of clays, mica chlorite, illite group, talc, pyrophyllite, wollastonite group, chemical properties, physical properties.

Fluxes: Soda and potash feldspar, other feldspars, nephlinesyenite, geology of formation, physical and chemical properties, beneficiation.

Silica and Silicate Materials: Silica, polymorphic modification, silica structure, physical and chemical properties of silica, silicate chemistry, minerals, sillimanite, kyanite, and alusite, availability in India and their uses in ceramic industry.

Other Raw Materials: Geology of bauxite, magnesite, dolomite, chrome, limestone, rutile, zircon, beryllia minerals, alumina, carbides, nitrides, properties and uses.

Textbooks:

1. 'Fine Ceramics Technology and Applications' by F.H.Norton, McGraw Hill Publishers, New York,

2. 'Ceramic Raw Materials' by W.E.Worrall, Pergamon press, New York.

Reference Books:

1. 'Forming Minerals' by W.A.Deer, R.A. Howie &J.Rock, Longman Publishers, London

2. 'Properties of Ceramic Raw Materials' by W.Ryan, Pergamon press, 2nd Edition

3. 'Clay Mineralogy' by M.J.Wilson, Chapman & Hall.

4. NANO SCIENCE & TECHNOLOGY

Course Objectives:

* To give foundational knowledge of the Nano scienceand related fields.

* To make the students acquire an understanding the Nano science and Applications

* To help the students understand in broad outline of Nanoscience and Nanotechnology.

Course Outcomes:

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

* Understand the properties of nanomaterials and their applications

* Synthesize nanoparticles

* Characterize nanomaterials

* Scale up the production of nanoparticles

* Understand applications of nanoparticles in nanobiology and nanomedicine

SYLLABUS

General Introduction: Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids, Mossbauer and Spectroscopy, optical phenomena bonding in solids, anisotropy,

Silicon Carbide: Application of silicon carbide, nano materials preparation, sintering of SiC, X-ray diffraction data, electron microscopy sintering of nano particles, nano particles of alumina and zirconia, nano materials preparation, characterization, wear materials and nano composites,

Mechanical Properties: Strength of nano crystalline SiC, preparation for strength measurements, mechanical properties, magnetic properties,

Electrical Properties: Switching glasses with nanoparticles, electronic conduction with nano particles,

Optical Properties: Optical properties, special properties and the coloured glasses Process of Synthesis of Nano Powders, electro deposition, important nano materials

Investigaing and Manipulating materials in the nanoscale: Electron microscope, scanning probe microscope, optical microscope for nano science and technology, X-ray diffraction

Nanobiology: Interaction between bimolecules and naoparticle surface,

different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, application of nano in biology, naoprobes for analytical applications - a new methodology in medical diagnostics and biotechnology, current status of nano biotechnology, future perspectives of nanobiology, nanosensors,

NanoMedicines: Developing of nano-medicines, nanosytems in use, protocols for nanodrug administration, nanotechnology in diagnostics applications, materials for used in diagnostics and therapeutic applications, molecular nanomechanics, molecular devices, nanotribology, studying tribology at nanoscale, nanotribology applications.

Text Books:

1. 'Nano Materials' by A.K.Bandyopadhyay, New Age Publishers
2. 'Nano Essentials'by T.Pradeep, TMH.

5. INDUSTRIAL SAFETY & MANAGEMENT

Course Objectives:

* To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models

* To understand about fire and explosion, preventive methods, relief and its sizing methods

* To analyse industrial hazards and its risk assessment.

Course Outcomes:

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

* Analyze the effects of release of toxic substances

* Select the methods of prevention of fires and explosions

* Understand the methods of hazard identification and prevention.

* Assess the risks using fault tree diagram

* Explain safety management in general and in industry specific

* Plan emergency preparedness and understand the occupational health hazards

SYLLABUS

Introduction :Industrial Safety, Incident, accident, near miss, hazard, risk, emergency, disasters, risk criteria, Safety at work.

Pediction and Evaluation of Unsafe Conditions: Identification of unsafe areas, unsafe acts, manifestation of unsafe conditions to emergency situation, lessons from accidents and disasters, safety audit and its elements, safety in plant layout, equipment design. Construction, erection, commissioning, material handling. Hazards – chemical hazards, thermodynamic hazards, electrical & electromagnetic hazards, mechanical hazards. Risk – Definition, causes, potential and adverse effects.

Hazard Analysis – incident scenarios, residual risk, Concept Hazard Analysis (CHA), Preliminary Process Hazard Analysis PPHA, HAZOP, Fault Tree Analysis (FTA), Event Tree Analysis (ETA).

Risk Assessment – Risk criteria, causes of death/damage, individual risk, societal risk, criteria for acceptable risk tolerable risk, application of risk assessment, computation of fatality rates, severity rates, vulnerability analysis, introduction to computerized risk assessment techniques.

Safety Management (General) – safety policy perceptions, safety organization, safety audit techniques, project and Construction Safety – welding & cutting operations, fabrication, material handling, equipment spacing, safe plant layout procedures, storage tanks, erection & commissioning works, housekeeping methods, maintenance of storage yards, erection & maintenance of electrical panels and MCC rooms, electrical & mechanical safe guarding. Emergency Preparedness – onsite & offsite emergency preparedness, emergency preparedness plans, site specific action plans and contingency plans, emergency facilities, rehabilitation & rescue operations, post emergency actions.

Safety Management (Industry Specific)- Chemical Manufacturing Plants, Fertilisers, Steel Plants, Petrochemical Plants, Metallurgical Plants, Mineral Process Industries, Sugar plants, semiconductor industry, Polymer manufacturing plans, Paper industry, Pharmaceutical and bulk drug industries, Vessel manufacturing industry, LPG bottling plants, Power Plants, tanneries and textiles.

Statutory Framework – key provisions of Factories Act, Environmental Protection Act, Manufacture, Storage and Import of Hazardous Chemical rules, Static and Mobile Pressure Vessels rules, NFPA specifications, OSHA regulations.

Occupational Health Management – occupational health perspectives, pre-employment & periodical medical examinations, diseases, causes, consequences, Occupational Health Hazards in Various Industries – aluminium industry, asbestos, battery manufacturing, sugar, cement, coke ovens, cotton ginning, dairy, electro plating, fish canning, poultries, irrigation, lead smelting, mining, pesticides, power plants, refineries, pulp & paper industry, PVC processing, steel plants, fertilizers, sulphuric acid plants, tanneries and textiles.

International Standards – British council's five star rating systems, International Safety Rating Systems (ISRS), ISO 14001 EMS, ISO 18001 OHSAS, BIS 14489 Code of Conduct for conducting safety audits.

Text Books:

1. "Hazards in Chemical industries, 3rd edition" – Authored by Frank P.Lees

2. "Hazard identification and risk assessment" – Authored by Geoff Wells; Published by Institution of Chemical Engineers, Davis Building, 165-189 Railway Terrace, Rugby, Warwickshire CV21 3HQ, UK.

Reference Books:

1. "Safety Management 5th edition" – Authored by John V. Grimaldi and Rollin H. Simonds; Published by A.I.T.B.S. Publishers & Distributors, J-5/6, Krishna Nagar, Delhi – 110051.

2. "Environmental Health and Safety Management" – Authored by Nicholas P. Cheremisinoff and Madelyn L. Graffia; Published by Jaico Publishing House, Hyderabad.

6. FUELS, REFRACTORIES AND FURNACES

Course Objectives:

* The main objective of this course is to study the different minerals used for the manufacturing of different types of refractories and its large scale applications in industries.

Course Outcomes:

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

* Understand the importance, types of refractories, properties, design and installation and different types of coatings on refractories.

* Explain about special refractories

* Describe refractories for iron & steel industry, Glass industry and cement & nonferrous industry

SYLLABUS

Introduction of Refractories: Production, demand and growth of refractories in India – layout of modern refractory plant – fundamental properties of refractories – Indian and international standards – factors for selection and use of refractories – test and quality control procedures.

Silica Refractories: Raw materials and composition – manufacturing process steps – quality of raw materials and process parameter on quartz inversion – glassy phase and other micro structural features – porosity, strength, RUL dependence on micro structure – specifications of silica refractories.

Alumina – Silica Refractories: Al_2O_3 – SiO_2 phase diagram – clay, pyrophyllite, sillimanite, grog, bauxite and diaspore as raw materials – manufacturing processes – micro structure and properties.

Basic Properties: Magnesite, forsterite, dolomite and chrome based refractories – raw materials and composition – manufacturing processes – micro structure and properties.

Special Refractories: Oxide based, carbide based and nitride based refractories – cordierite – zirconia – carbon – fusion cast refractories, slide gate, purging refractories, and continuous casting refractories – ceramic fibres.

Refractories for Iron and Steel Industry: Coke oven, blast furnace, twin hearth, LD converter – continuous casting – electric arc furnace, induction furnaces – reheating furnaces – slide plate system – nozzle, shroud/ SDN – ladle and tundish lining practices – monolithic - gunning techniques – refractor, slag and metal interactions.

Refractories for Cement and Non Ferrous Industry : Wet/ dry process for cement making – preheater and pre calcinatory and zone lining – alkali and wear resistance – refractory requirement and use in copper, aluminum and hydro carbon industry – use of monolithic.

Refractories for Glass Industry : Design of glass tank for container, sheet, lamp, float glasses, refractory practices in side wall, throat, forehearth, and roof of glass tanks – regenerator systems – alumina and AZS fused cast refractories – glass corrosion resistance, oxidation, seed potential tests – glass defects and analysis – feeder expendables.

Refractories for Ceramic Industry: Kiln furniture – types – properties of requirement - silicon carbide, mullite, corderite, alumina, zirconia – mullite, zirconia types – kiln design – LTM concept – fast firing technology.

Refractories for Energy Conservation: Insulation refractories – types-ceramic fiber product – design and installation – ceramic coatings – case studies in ceramic fiber usage.

Textbook:

B. M. Coop and E. M Piekson, Raw Materials for the refractory industries and industry materials and consumer survey, 1981.

Reference Books:

1. J. H. Eheslers Refracrtories: production and Properties. Iron and Steel Institute, London, 1972.

2. Akira Nistrikawa, Technology of monolithic refractories, Plibrico japan co. Tokyo 1984

3. D.N. Nandi, Hand Book Refractory's, Tata Mc Graw hill publishing Co. New Delhi 1991

4. K.Shaw, Refractories and thick uses ADP sciences publisher U K 1972

5. Keishi GOTON, Powder Technology Hand Book, Marcel Dekker Inc. 1997

6. Chester J.H., Steel Plant Refractories, 2nd Edition, 1973, United Steel Companies Limited, Sheffield UK

7. Advances in Refractory Technology, Ed. Robert E Fisher, Ceramic Transaction Vol 4., American Ceramic society, 1990, Westerville, Ohio, USA.

7. BIOCHEMICAL ENGINEERING

Course Objectives:

* To apply the chemical engineering principles in biological systems.

Course Outcomes

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

* Understand cell and enzyme kinetics
* Discuss methods of immobilization
* Calculate volume of a fermentor
* State sterilization methods
* Select downstream process to separate the products
* Estimation using various Bioanlytical techniques

SYLLABUS

Introduction to Biochemical Engineering and Biotechnology: Overall view of biotechnology since its practice–to date, enzyme kinetics, derivation of M.M. equation of single as well as multiple substrates, enzyme inhibition, determination of M.M. parameters, industrial applications of enzymes,

Cell Cultivation & Kinetics: Microbial, animal and plant cell cultivation, cell immobilization, batch growth of cells, yield coefficient, monod growth kinetics,

Analysis and Design of Fermenters: Batch fermenter, mixed flow fermenter (chemostat), plug flow fermenter, mixed flow fermenters in series, and cell recycling,

Genetic Engineering: DNA and RNA, cloning of genes, stability of recombinant microorganisms, gene manipulation,

Sterilization: Sterilization of media and air, thermal death kinetics, design criterion, continuous sterilization methods,

Aeration and Agitation in Fermenters: Correlations of mass transfer coefficient, measurement of interfacial area and gas holdup, power consumption, scale up concepts,

Bioanalytical Techniques: Gas chromatography, thin layer and paper chromatography, HPLC, affinity, gel, adsorption and ion exchange chromatography.

Text Book:

'Biochemical Engineering Fundamentals' 2nd edition by J.E.Bailey and D.F.Ollis, McGraw-Hill Publishers, Newyork, 1986

Reference Books:

1. 'Chemical Engineering' volume-3, 3rd Edition by J.F Richardson and D.G. peacock, (Chapter-5: Biochemical Reaction Engineering), Pergomon Press, U.K, 1994

2. 'Bioprocess Engineering: Basic Concepts' 2nd edition by M.L.Shuler and F.Kargi, Prentice Hall India, New Delhi, 2003

3. 'Biochemical engineering' by D.G. Rao, Tata McGraw-Hill Publishers, New Delhi,

4. 'Biochemical Engineering' by J.M. Lee, Prentice Hall, Englewood Clifts, 1992.

8. INDUSTRIAL POLLUTION CONTROL ENGINEERING

Course Objectives:

* To understand the types of emissions from chemical industries and their effects on environment, remedial measures.

* To enable the students to design water treatment system & to acquire knowledge on proper management of solid wastes.

* To provide a general idea about safety in chemical industries.

Course Outcomes:

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

* Analyze the effects of pollutants on the environment
* Distinguish air pollution control methods
* Assess treatment technologies for wastewater
* Identify treatment technologies for solid waste
* Identify and manage industrial hazards

SYLLABUS

Types of Emission from chemical industries and their effects on environment, Environmental legislation, noise pollution, occupational health hazards, meteriological factors in pollution dispersion (ALP and ELP), plume behaviour and characteristics, chimney design considerations: Plume raise, effective stack height,

Methods of Analysis of Air Pollutants, particulate matter, SO_x, NO_x, CO_x analysis, removal of particulate matters: principles and design of setting chambers, solid traps, cyclone separators, fabric and design of fibre filters, scrubbers and electrostatic precipitators,

General Methods of Control and removal of sulphur dioxide, oxides of nitrogen, organic vapors from gaseous effluents with design aspects, sources of waste waters, effluent guidelines and standards, characterization of effluent

streams, oxygen demanding wastes, oxygen sag curve, BOD curve, analysis of water pollutants,

Methods of Primary Treatment: Screening, sedimentation, floatation and neutralization, biological treatment, bacteria and bacterial growth curve, aerobic processes suspended growth processes, activated sludge process, extended aeration, contact stabilization, aerated lagoons and stabilization ponds, attached growth process with design aspects, trickling filters, rotary drum filters, fluidized bed contactors, anaerobic processes,

Methods of Tertiary Treatment: Carbon adsorption, ion exchange, reverse osmosis, ultra filtration, chlorination, ozonation & sonozone process, sludge treatment and disposal,

Solid Waste Management: solid waste collection, transportation, solid waste processing and recovery, hazards in waste management, risk assessment and safety measures, types of hazardous wastes, health effects, safety measures, risk assessment response measures, case studies or pollutants removal and safety measures in fertilizer, petrochemical, paper, pharmaceutical industries and petroleum refinery,

Industrial Safety: Why safety, accidents, causes and remedial measures, safety aspects of site selection, plant layout and unit plot planning, hazards of commercial chemical operations and reactions, safety aspects of process design, instrumentation for safe operations, safety aspects in design and inspection of pressure vessels, effect of toxic agents, toxicity vs hazards, respiratory hazards, safe experimentation and testing of reactions, materials for safety,

Flamable Materials: Fire extinguishing agents and their applications, eye safety in chemical processing, personnel protective equipment, permit systems, hazard evaluation techniques, modern safety management systems, safety effectiveness.

Text Books:

1. 'Environmental Pollution Control', by C.S. Rao, Wiley Eastern Limited

2. 'Safety and Accident Prevention in Chemical Operations' by Fawcett and Wood

Reference Books:

1. 'Environmental Engineering' by Arcdio P.Sincero and Geogoria Sincero

2. 'Loss Prevention in Chemical Industries' by Frank P.Lees

9. CO2 CAPTURE, SEQUESTRATION & UTILIZATION

Course Objectives:

The student will be able to learn

* Global status of CO2 emission and regulatory interventions

* To recover CO2 from power plants

* About the reagents and process to recover CO2

* Utilization of CO2 and Storage systems

Course Outcomes:

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

* Identify the necessity of CO2 capture, storage and utilization

* Distinguish the CO2 capture techniques

* Evaluate CO2 Storage and sequestration methods

* Assess Environmental impact of CO2 capture and utilization

SYLLABUS

Introduction: Global status of CO2emission trends, Policy and Regulatory interventions in abatement of carbon footprint, carbon capture, storage and utilization (CCS&U)

CO2 Capture Technologies from Power Plants: Post-combustion capture, Pre-combustion capture,Oxy-fuel combustion, chemical looping combustion, calcium looping combustion

CO2 Capture Agents and Processes: Capture processes, CO2capture agents, adsorption, ionic liquids, metal organic frameworks

CO2 Storage and Sequestration: Geological sequestration methods, Biomimetic carbon sequestration

CO2 Utilization: CO2derived fuels for energy storage, polymers from CO2, CO2based solvents, CO2to oxygenated organics, Conversion into higher carbon fuels, High temperature catalysis

Environmental Assessment of CO2 Capture and Utilization: Need for assessment, Green chemistry and environmental assessment tools, Life cycle assessment (LCA), ISO standardization of LCA, Method of conducting an LCA for CO2capture and Utilization.

Text Books:

1. Carbon dioxide utilization: Closing the Carbon Cycle, Peter Styring, Elsje Alessandra Quadrelli, KatyArmstrong, Elsevier,2015,1st Edition.

2. Carbon Capture, Storage and, Utilization: A Possible Climate Change Solution for Energy Industry, GoelM, Sudhakar M, ShahiRV, TERI, Energy and Resources Institute, 2015, 1st Edition.

3. Carbon Capture and Storage, CO2 Management Technologies, Amitava Bandyopadhyay, CRC Press, 2014, 1st Edition.

Reference Books:

1. Calcium and Chemical Looping Technology for Power Generation and Carbon Dioxide (CO2) Capture, Fennell P, Anthony B, Wood head Publishing Series in Energy: No. 82, 2015, 1st Edition.

2. Developments in Innovation in Carbon Dioxide Capture and Storage Technology: Carbon Dioxide Storage and Utilization, Mercedes Maroto-Valer M, Vol 2, Wood head Publishing Series in Energy, 2014, 1st Edition.

3. Fundamentals of Enhanced Oil and Gas Recovery from Conventional and Unconventional Reservoirs, Alireza Bahadori, Elsevier Inc., 2018, 1st Edition.

10. DESIGN OF EXPERIMENTS

Course Objectives:

The student will be able to learn

* The basic guidelines of designing experiments
* Parametric estimation
* Fitting first/second order models
* Optimization of the given problem

Course Outcomes:

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

* Design experiments for a critical comparison of outputs
* Propose hypothesis from experimental data
* Implement factorial and randomized sampling from experiments
* Estimate parameters by multi- dimensional optimization

SYLLABUS

Introduction: Strategy of experimentation, basic principles, guidelines for designing experiments. Simple Comparative Experiments: Basic statistical concepts, sampling and sampling distribution, inferences about the differences in means: Hypothesis testing, Choiceof samples size, Confidence intervals, Randomized and paired comparison design.

Experiments with Single Factor: An example, The analysis of variance, Analysis of thefixed effect model, Model adequacy checking, Practical interpretation of results, Sample computer output, Determining sample size, Discovering dispersion effect, The regression approach to the analysis of variance, Non-parametric methods in the analysis of variance, Problems.

Design of Experiments: Introduction, Basicprinciples: Randomization, Replication, Blocking, Degrees of freedom, Confounding, Design resolution, Metrology considerations for industrial designed experiments, Selection of quality characteristics for industrial experiments. Parameter Estimation.

Response Surface Methods: Introduction, The methods of steepest ascent, Analysis of a second- order response surface, Experimental designs for fitting response surfaces: Designs for fitting the first-ordermodel, Designs for fitting the second-ordermodel,Blocking in response surface designs, Computer-generated (Optimal) designs, Mixture experiments, Evolutionary operation, Robust design, Problems.

Design and Analysis: Introduction, Preliminary examination of subject of research, Screening experiments: Preliminary ranking of the factors, active screening experiment- method of random balance, active screening experiment Plackett-Burman designs, Completelyrandomizedblockdesign, Latinsquares,Graeco-Latin Square, Youdens Squares, Basic experiment-mathematical modelling, Statistical Analysis, Experimental optimization of research subject: Problem of optimization, Gradient optimization methods, Nongradient methods of optimization, Simplex sum rotatable design, Canonical analysis of the response surface, Examples of complex optimizations.

Text Books:

1. Lazic Z.R., Design of Experiments in Chemical Engineering, A Practical Guide, Wiley, 2005.

2. Antony J., Design of Experiments for Engineers and Scientists, Butter worth Heinemann, 2004.

3. Montgomery D.C., Design and Analysis of Experiments, Wiley, 5th Edition, 2010.

4. Doebelin E. O., Engineering Experimentation: Planning, Execution, Reporting, McGraw- Hill, 1995.

11. RENEWABLE ENERGY SOURCES

Course Objectives:

The student will be able to learn

* Various sources of energy
* Direct/indirect utilization of solar energy
* Wind energy conversion and types of wind machines
* OTEC systems and application of Geothermal energy

Course Outcomes:

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

* Identify the challenges and problems associated with the use of energy sources.
* Illustrate the renewable energy technologies.
* Distinguish conversion technologies for solar, wind, biomass and hydrogen energies
* Evaluate the performance of energy conversion technologies

SYLLABUS

Sources of Energy: Energy sources and their availability, renewable energy sources. Energy from Biomass: Introduction, Biomass as a source of energy, Biomass conversion technologies, Biogas generation, classification of biogas plants, Biomass gasification.

Solar Energy: Sun and solar energy, solar radiation and its measurement, solar energy collectors, solar energy storage, Photovoltaic systems, Application of solar energy

Wind Energy: Wind as an Energy source, Basic principles of wind energy conversion, Types of Wind machines, Components of wind energy conversion system, Performance of wind machines, application of wind energy.

Geothermal Energy: Introduction, Origin and distribution of geothermal energy, types of geothermal resources, Hybrid geothermal power plant, Application of geothermal

Energy Hydrogen Energy: Introduction, Hydrogen production, Hydrogen storage, Hydrogen transportation Energy from the Oceans: Introduction, Ocean Thermal Electric Conversion (OTEC), Energy from Tides, Ocean Waves Chemical Energy Sources. Introduction to Fuel cells, and Batteries.

Text Books:

1. Non-Conventional Energy Sources, Rai, G.D, Khanna Publishers, New Delhi, 2010.

2. Non-conventional Energy Sources, RajeshKumarPrasad, T.P.Ojha, Jain Brothers, 2012.

3. Solar energy–Thermal Collection and storage, SukhatmeS. PandJ. Nayak, Tata McGraw Hill Education Pvt. Ltd., 2008, 3rdEdition.

4. Power Plant Technology, MM. ElWakil, Tata McGraw Hill, NewYork,1999

12.ENERGY TECHNOLOGIES

Course Objectives:

The student will be able to learn

* Conventional and non conventional energy sources

* Direct solar energy conversion using photovoltaic cells

* Recovery streams of heat from the product streams using waste heat boilers

* Energy conversion and management

Course Outcomes:

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

* Identify the Energy sources and its exploration

* Design process equipment for alternative energy sources

* Explain the principles of solar cells and fuel cells

* Analysis for energy accounting & auditing

SYLLABUS

Conventional Energy Sources: Formation of fossil fuels &resources. Energy sources: Coal; Oil; Natural gas; Hydropower. Coal Gasification & Liquefaction; Synthetic fuels; Hydrogen; Methods & applications of Cogeneration; Fluidized-bed combustion, combined cycle plants. Role of coal in energy crisis.

Non-conventional Energy Sources: Study of power plants using energy sources like solar, wind, geothermal, ocean thermal, tide. Design of Biogas plant; Biomass energy; Alternative fuels from biomass.

Direct Energy Conversion: Solar cells; Photovoltaic cells; Theory of junction-type cells & construction details. Fuel cells: types; practical considerations; construction & working details. Principles of MHD power generation. Nuclear energy: Nuclear fuels; Fission-type reactor.

Waste Heat Recovery: Heat pump; Demand of energy & Forecasting; Principles of energy accounting & auditing; economics; Principles of energy management; Technology assessment with reference to case studies.

Energy Conservation & Management: Energy Scenarioin the World and Indiain 21st century. Exploration of energy resources based on combustion.

Text Books:

1. Energy Technology–Nonconventional, Renewable & conventional, S.Rao, Khanna Publishers, New Delhi.

2. An Introduction to Power Plant Technology, G.D.Rai, Khanna Publishers, New Delhi.

3. Non-conventional Energy Sources, G.D.Rai, Khanna Publishers ,New Delhi

HSS ELECTIVES

1. INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP

Course Objectives:

* To familiarize the students with the concepts of Management.

* To relate the concepts of Management with industrial organizations.

* To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.

* To set forth a basic framework for understanding Entrepreneurship.

Course Outcomes:

* On completion of the course, the students will be able to:

* Understand the roles, skills and functions of management.

* Distinguish the different types of business organizations.

* Identify the factors involved in Production Operations Management.

* Diagnose organizational problems and take suitable decisions.

* Establish good Human Resource Management practices.

* Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

SYLLABUS

Basic Concepts of Management:

Management : Definition, Nature and Importance ; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

Forms of Business Organizations: Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Production and Operations Management: Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Entrepreneurship: Definition, Characteristics and Skills , Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Entrepreneurial Development and Project Management: Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques; Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

Text Books:

1. Industrial Organization & Engineering Economics by Sharma,S.C, and Banga, T.R., Khanna Publishers, Delhi, 2000.

2. The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth) by Vasant Desai, HImalayan Publishing House, 2018.

Reference Books:

1. Management Science, by Aryasri , A.R., McGraw HIll Education (India Private Limited , New Delhi 2014.

2. Entrepreneurship by Sheela, P. and Jagadeswara Rao, K., Shree Publishing House, Guntur, Andhra Pradesh, 2017.

2. ORGANIZATIONAL BEHAVIOUR

Course Objectives:

* To understand the basic concepts of organisational behaviour, its foundations and importance.

* To enable students to have a basic perspective of Motivation and Motivation theories.

* To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

Course Outcomes:

* Indentifying fundamental aspects of organizational dynamics.

* Evaluate main theories of motivation and formulating suitable motivational strategies.

* Analyze the behaviour of individuals and groups in organizations.

* Understanding of Leadership theories and Leadership behaviour.

* Apply relevant theories, concepts to address important Organizational Behaviour questions.

SYLLABUS

Organizational Behaviour : Concept of Organisation - Concept of Organisational Behaviour - Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing to Organisational Behaviour.

Motivation: Définition - Nature of Motivation - Role of Motivation - Théories of Motivation : Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

Group Dynamics: Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

Leadership: Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

Communication: Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of

communication : Down Ward, Up Ward and Horizontal communication.

Organisational Conflicts: Concept of Conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intra group conflict, Inter group conflict, Inter Organizational conflict - Conflict management.

Organizational Change: Nature - Factors in Organizational change - Planned change: Process of Planned change - Resistance to change: Factors in résistance to change – Over coming résistance to change.

Text Books :

1. Organizational Behaviour by L.M.Prasad: Sultan Chand & Sons, New Delhi -110002

2. Organisational Behaviour by K. Aswathappa:, Himalaya Publishing House, New Delhi

Référence Book :

Organizational Behaviour by Stephen Robbins:, Pearsons Education, New Delhi.

3. OPERATIONS RESEARCH

Course Objectives:

* Formulate a real world problem as a mathematical programming model.

* Provide knowledge of optimization techniques and approaches.

* Understand and study inventory problems.

* Know the network models.

* Put on knowledge in solving replacement problems and different queuing models

Course Outcomes:

* Learned to translate a real-world problem into a mathematical formulation.

* Formulate and Solve Transportation, Assignment and sequencing problems.

* Resolve inventory problems.

* Able to solve maximum flow and shortest path problems.

* Capable to solve replacement problems and analyze queuing models.

SYLLABUS

Introduction: Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

Allocation: Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

Transportation: Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

Assignment: Formulation; Variations in Assignment problem; Travelling salesman problem.

Sequencing: Sequencing of - n jobs through two machines; n jobs through three machines; n jobs through m machines; 2 jobs through m machines.

Inventory Control: Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

Network Analysis: Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

Replacement: Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

Queuing Models: Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queue with infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

Text Books:

1. Operations Research- An Introduction" by Hamdy A Taha, TAHA , Prentice Hall, 2009.

2. "Introduction To Operations Research by F.S. Hiller, G.J. Liberman,B. Nag and P.Basu Mc Graw Hill Education (India), 2012.

3. "Operations Research" by S.D.Sharma Kedarnadh Ramnadh & Co., 2017

Reference Books:

1. "Operations Research" by R. Pannerselvam, PHI..

2. "Operations Research" by Richard Bronson, Schaum's Series, Mc Graw Hill

3. "Operations Research- Theory and Practice" by N.V.S.Raju, BS publications.

4. "Operations Research" by V.K. Kapoor, Sultan Chand & Sons.