CHEMICAL ENGINEERING
VII SEMESTER

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1129	Chemical Process Equipment Design-II	4	0	0	4
ACH1130	Transport Phenomena	4	1	0	4
ACH1131	Chemical Engineering Mathematics	4	1	0	4
ACH1132	Membrane Separation Processes	4	0	0	4
	Elective-I	4	0	0	4
ACH1133	Applied Numerical Methods				
ACH1134	Corrosion Engineering				
ACH1135	Safety and Hazard Analysis				
AME1135	Non-Conventional Sources of Energy				
AEC1130	Bio-Medical Instrumentation				
	Elective-II	4	0	0	4
ACH1136	Polymer Engineering				
ACH1137	Petroleum Refining and Petrochemicals				
ACH1138	Energy Engineering				
AIT1114	Data Structures for Engineering Applications	4	1	0	4
ACS1115	Software Development Engineering				
ACH1139	*Computer Aided Design of Chemical Equipment Lab*	*0*	*0*	*3*	*2*
ACH1140	*Application Of MATLAB In Chemical Engg*	*0*	*0*	*3*	*2*
ACH11MP	*Industry Oriented Mini-Project*	-	-	-	*2*
	Total	**24**	**2**	**6**	**30**

* Mini Project to be carried out during the summer vacation after VI Semester examination

* Evaluation at the beginning of the VII Semester

CHEMICAL PROCESS EQUIPMENT DESIGN-II

Course Code: ACH1129

L	T	P	C
4	0	0	4

AIM :

To provide students with useful design methods and techniques required in different unit operations of chemical industry

OBJECTIVE:

This course introduces the student to the design of some chemical Engg. Equipment.

UNIT-I

Tray type of absorbers: criteria for selection, types of distributors, calculation of number of plates, and pressure drop.

UNIT –II

Packed bed type of absorbers: Types of packing, Height of transfer unit, Number of Transfer units, overall column height, Pressure drop calculations.

UNIT-III

McCabe-Thiele method, for binary distillation , Fensky-Underwood-Gillilands method calculation of minimum reflux, minimum plates and real number of plates.

UNIT-IV

Criteria for selection of distillation column, selection of key components, selection of operating pressure.

UNIT-V

Determination of distillation column diameter, selection of liquid flow pattern, total pressure drop in column, design of downcomer, Tray efficiency and height equivalent of theoretical plate, Tray efficiency, calculation of flooding velocity and weping velocity

UNIT-VI

Types of extractors (mixer-settler, un-agitated columns, agitated columns, centrifugal extractor), selection of extractors, selection of solvents, process design of extractors, supercritical extraction

UNIT-VII

Types of reactors, process design of batch reactor and continuous flow reactors, selection of reactor

UNIT-VIII

Process design of piping, process design of pumps blowers and extractors, flow meters, process design of orifice meters and rotameters.

TEXT BOOKS:

1. Coulson J.M and Richardson J.F, "Chemical Engineering", Vol. 6, Pergamon Press, 4 Ed, 2005.
2. Thakore S.B. and Bhat, B.I, "Introduction to Process Engineering and Design", Tata McGraw-Hill Publishing Co., New Delhi, 2007.
3. Seader J.D., and Henley E.J, "Separation Process Principles", John Wiley, New York , 2 Ed, 2006.

TRANSPORT PHENOMENA

Course Code: ACH1130

L	T	P	C
4	1	0	4

AIM :

To give a balanced overview on the field of Transport phenomena, present fundamental equation s and illustrate how to solve them.

OBJECTIVES:

As transport phenomena includes three closely related topics like Momentum, Mass and energy transport, this subject will enable the student to apply these concepts in various chemical process engineering aspects and help them be better designers

UNIT-I

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity (molecular momentum transport), generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density, molecular theory of the viscosity of liquids.

UNIT-II

Thermal conductivity and the mechanisms of energy transport: Fourier's law of heat conduction (molecular energy transport), temperature and pressure dependence of thermal conductivity, and theory of thermal conductivity of gases at low density.

UNIT-III

Diffusivity and the mechanisms of mass transport: Fick's law of binary diffusion (molecular mass transport), temperature and pressure dependence of diffusivities, theory of diffusion in gases at low density.

UNIT-IV

Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film, flow

through a circular tube, flow through annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere.

UNIT-V

Shell energy balances and temperature distributions in solids and laminar flow: shell energy balances; boundary conditions, heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a viscous heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin, forced convection, free convection.

UNIT-VI

Concentration distributions in solids and laminar flow: shell mass balances; boundary conditions, diffusion through a stagnant gas film, diffusion with a heterogeneous chemical reaction, diffusion with a homogeneous chemical reaction, diffusion into a falling liquid film (gas absorption), diffusion into a falling liquid film (solid dissolution), diffusion and chemical reaction inside a porous catalyst.

UNIT-VII

The equations of change for isothermal systems: the equation of continuity, the equation of motion, the equation of mechanical energy, the equation of angular momentum, the equations of change in terms of the substantial derivative, use of the equations of change to solve flow problems. Velocity distributions in turbulent flow: comparisons of laminar and turbulent flows, time- smoothed equations of change for incompressible fluids, the time-smoothed velocity profile near a wall.

UNIT-VIII

The equations of change for non- isothermal systems: the energy equation, special forms of the energy equation, the boussenis equation of motion for forced and free convection, use of the equations of change to solve steady state problems. The equations of change for multi component systems: the equations of continuity for a multi component mixture.

TEXT BOOK:

Bird R.B., Stewart W.C., Lightfoot F.N., “Transport phenomena”, John Wiley & Sons,U.S.A,2 Ed 1960.

REFERENCES:

1. Theodore, L. "Transport Phenomena for Engineers", International text book company, U.S.A.1971.
2. Geankoplis, C.J. "Transport Processes and Unit Operations", PHI, New Delhi, 3,Ed , 1997.
3. Welty J.R, Wicks C.E, Wilson R.E, "Fundamental of Momentum, Heat and Mass Transfer", John Wiley, 4 Ed, 2009.

CHEMICAL ENGINEERING MATHEMATICS

Course Code: ACH1131

L	T	P	C
4	1	0	4

AIM :

The aim of this course is to introduce the student the concept of mathematical modeling.

OBJECTIVES:

This course teaches the student the various analytical techniques to solve the Mathematical models.

UNIT-I

FORMULATION OF PHYSIOCHEMICAL PROBLEMS:

Introduction, Illustration of the Formulation Process (Cooling of Fluids), Combining Rate and Equilibrium Concepts (Packed Bed Adsorber), Boundary Conditions and Sign Conventions, Summary of the Model Building Process, Model Hierarchy and its Importance in Analysis.

UNIT-II

SOLUTION TECHNIQUES FOR MODELS YIELDING ORDINARY DIFFERENTIAL EQUATIONS (ODE) :

Geometric Basis and Functionality, Classification of ODE, First Order Equations, Exact Solutions, Equations Composed of Homogeneous Functions, Bernoulli's Equation, Riccati's Equation, Linear Coefficients, First Order Equations of Second Degree,

UNIT-III

Solution Methods for Second Order Nonlinear Equations, Derivative Substitution Method, Homogeneous Function Method, Linear Equations of Higher Order, Second Order Unforced Equations: Complementary Solutions, Particular Solution Methods for Forced Equations, Summary of Particular Solution Methods, Coupled Simultaneous ODE, Summary of Solution Methods of ODE.

UNIT-IV

SERIES SOLUTION METHODS AND SPECIAL FUNCTIONS:

Introduction to Series Methods, Properties of Infinite Series, Method of Frobenius, Indicial Equation and Recurrence Relation, Summary of the Frobenius Method, Special Functions, Bessel's Equation, Modified Bessel's Equation, Generalized Bessel Equation, Properties of Bessel Functions, Differential, Integral and Recurrence Relations.

UNIT-V

INTEGRAL FUNCTIONS:

Introduction, The Error Function, Properties of Error Function, The Gamma and Beta Functions, The Gamma Function, The Beta Function, The Elliptic Integrals, The Exponential and Trigonometric Integrals.

UNIT-VI

STAGED-PROCESS MODELS: THE CALCULUS OF FINITE DIFFERENCES:

Introduction, Modeling Multiple Stages, Solutions Methods for Linear Finite Difference Equations, Complementary Solutions, Particular Solution Methods, Method of Undetermined Coefficients, Inverse operator Method, Nonlinear Equations (Riccaati Equation).

UNIT-VII

LAPLACE TRANSFORMS:

Laplace Transformations: Building Blocks, Taking the Transform, Transforms of Derivatives and Integrals, The Shifting Theorem, Transform of Distribution Functions, Practical Inversion Methods, Partial Fractions, Convolution Theorem, Applications of Laplace Transforms for Solutions of ODE.

UNIT-VIII

SOLUTION TECHNIQUES FOR MODELS PRODUCING PDEs:

Introduction, Classification and Characteristics of Linear Equations, Particular Solutions for PDEs, Boundary and Initial Conditions, Combination of Variables Method, Coated Wall Reactor, Orthogonal Functions and

Sturm-Liouville Conditions, The Sturm-Liouville Equation, Inhomogeneous Equations, Applications of Laplace Transforms for Solutions of PDEs.

TEXT BOOK :

1. Richard, G. R. and. Do, D. D. "Applied Mathematics and Modeling for Chemical Engineers", John Wiley & Sons, New York, 1995.

REFERENCE :

1. Mickley, H.S.,Sherwood, T.K. and Reed, C.E,Applied Mathematics in Chemical Engineering, 2 ed., Tata McGraw-Hill, New Delhi Publications, 1975.
2. Jenson, V.J. and Jeffereys , G.V "Mathematical Methods in Chemical Engineering", Academic Press New York 2 Ed, 1977.

MEMBRANE SEPARATION PROCESSES

Course Code: ACH1132

L	T	P	C
4	0	0	4

AIM:

This course explains the general aspects and importance of various membrane processes and the various mechanism involved in membrane based separations.**(QualitativeTreatment only)**

OBJECTIVES:

Membrane are finding an important role in various operation in the industry. The courses introduces to these useful operations

UNIT-I

INTRODUCTION: Separation process, membrane processes, definition of a membrane, classifications membrane processes.

UNIT-II

PREPARATION OF SYNTHETIC MEMBRANES: Types of Membrane materials, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes.

UNIT-III

CHARACTERIZATION OF MEMBRANES: Introduction, membrane characterization, characterization of porous membranes, characterization of non-porous membranes.

UNIT-IV

MEMBRANE PROCESSES: Introduction, pressure driven membrane processes: Introduction, microfiltration, membranes for microfiltration, industrial applications, ultrafiltration: membranes for ultrafiltration, industrial applications, reverse Osmosis and nanofiltration: membranes for reverse osmosis and nanofiltration, industrial applications.

UNIT-V

ELECTRICALLY DRIVEN PROCESSES: Introduction, electrodialysis, Process parameters, membranes for electrodialysis, applications, Membrane electrolysis, Bipolar membranes, Fuel Cells.

UNIT-VI

CONCENTRATION DRIVEN MEMBRANE PROCESSES: Gas separation: Membranes for gas separation, applications, pervaporation, membranes for pervaporation, applications, dialysis: membranes for dialysis, applications, liquid membranes: aspects, liquid membrane development, choice of the organic solvent and carrier, Applications.

UNIT-VII

POLARIZATION PHENOMENON AND FOULING: Introduction to concentration polarization, turbulence promoters, pressure drop, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling.

UNIT-VIII

MEMBRANE MODULES: Introduction, plate and frame module, spiral wound module, tubular module, capillary module, hollow fiber module, comparison of module configurations.

TEXT BOOKS:

1. Marcel Mulder, Basic Principles of Membrane Technology, Springer Publications 2 Ed., 2007

REFERENCES:

1. Nunes, S.P, Peinemann, K.V, "Membrane Technology in the chemical industry", Wiley-VCH, 2 Ed, 2006.
2. Rautanbach and Albrecht, R., "Membrane Process", John Wiley & Sons.,1989.
3. Crespo, J.G., Bodekes, K.W., "Membrane Processes in separation and Purification", Kluwer Academic Publications.Netherland,1994.
4. Geankoplis, C.J. "Transport processes and Unit Operations" PHI, New Delhi, 3 Ed, 2002.
5. Wankat, R. C. "Rate- Controlled Separations", Springer, 1994.

APPLIED NUMERICAL METHODS

(ELECTIVE-I)

Course Code: ACH1133

L	T	P	C
4	0	0	4

AIM:

This course trains the students in learning and applying numerical techniques to solve the usual chemical engineering problems.

OBJECTIVES:

Numerical techniques are needed to solve non-linear problems and this course teaches some of these techniques.

UNIT-I

NONLINEAR ALGEBRAIC EQUATIONS: Introduction, simple fixed point method, Two variable Newton-Raphson Technique, Simultaneous Non linear equations.

UNIT-II

LEAST SQUARES REGRESSION : Linear Regression, Polynomial Regression, Non linear Regression.

UNIT-III

ODV INITIAL VALUE PROBLEMS (IVP): Introduction: Importance of IVP, Euler-Explicit and Implicit methods, R-K Methods.

UNIT-IV

ODE BOUNDARY VALUE PROBLEMS(BVP): Introduction: Importance of BVP's, shooting method technique to solve ODE BVP's.

ODE BVP'S APPLICATIONS : PFR with non linear kinetics and axial diffusion, Heat Transfer through a Fin, effectiveness factor calculation for slab and spherical geometries.

UNIT-V

ODE FINITE DIFFERENCE METHOD(FDM): Importance:

Forward, Backward and Central Difference schemes, Methods for solving problems of PFR with non linear kinetics and axial diffusion, Heat Transfer through a Fin, effectiveness factor of a slab and spherical geometries.

UNIT-VI

PARTIAL DIFFERENTIAL EQUATION (PDE) –FDM APPLICATIONS : Importance: Forward, Backward, Central differencing schemes, Implicit and Explicit schemes for Unsteady state problems, Crank-Nicholson scheme. Applications: 2 Dimensional steady state Heat Transfer, Unsteady Heat Transfer with 1 dimensional space.

UNIT-VII

ORDINARY DIFFERENTIAL EQUATIONS (ODE) - ORTHOGONAL COLLOCATION(OC) APPLICATIONS: Importance: Theory of Legendre Polynomials, Generating the Matrices for OC, solving Heat Transfer through a Fin, Effectiveness factor calculation for a slab and spherical geometry.

UNIT-VIII

PARTIAL DIFFERENTIAL EQUATION (PDE) – OC APPLICATIONS: 2 Dimensional steady state Heat Transfer, Unsteady Heat Transfer with 1 dimensional space.

TEXT BOOK:

Gupta, S.K. "Numerical Methods for Engineers" New Age International (P) Ltd, 1995.

REFERENCE :

Rice, R.G. and. Do, D.D., "Applied Mathematics and Modeling for Chemical Engineers", John Wiley & Sons, New York, 1995.

CORROSION ENGINEERING

(ELECTIVE-I)

Course Code: ACH1134

L	T	P	C
4	0	0	4

AIM:

This course introduces the student the basics of electro chemistry and corrosion Engg.

OBJECTIVES:

Corrosion is a major industrial problem and the present course introduces the student the technical aspects of Corrosion Engg., their measurement & prevention.

UNIT-I

Definitions-explanation with suitable examples Factors affecting the choice of Engineering Material-Factors affecting Corrosion resistance-Dry Corrosion , Wet Corrosion- Corrosive media or environments- acidic, basic, neutral marine-Corrosion Rate expressions-Effect of aeration, flow rate of the medium, corrosive concentration, temperature, pH on the rates of Corrosion. Direct and indirect costs due to corrosion in Industrial practice- Corrosion rates determination from weight loss measurements.

UNIT-II

Basic electrochemical relevant to corrosion-Anode, Cathode, electrolyte, conductivity, resistivity, Electrochemical theories of Corrosion- relevant reactions at the respective metal/alloy electrodes, Mixed Potential theory of Electrochemical Corrosion, Electrode potentials- reversible and irreversible - EMF series, Galvanic Series their significance in corrosion monitoring-Corrosion Potential-representation by Evans Diagrams-Polarization-Over voltage, Activation and Concentration polarization-Tafels Equation, Tafels constants in determination of Corrosion Current densities and Corrosion rates- Nernst Equation and determination of Corrosion potentials. Thermodynamic aspects of Corrosion reactions-Potential-pH phase diagram for Iron-Water system.

UNIT-III

A Corrosion Cell –its components with examples –types of corrosion cells generally encountered-concentration cells, galvanic or dissimilar metal cells, temperature differentiation cells, Differential aeration cells. Forms of Corrosion-Uniform, Pitting, crevice corrosion, Cavitation erosion, impingement attack, Parting, Corrosion fatigue- metallurgical aspects affecting corrosion reactions Area effect, Grain boundary effect.

UNIT-IV

Dezincification, Intergranular Corrosion, mechanism and remedial measures, Stress Corrosion Cracking, Caustic embrittlement, Hydrogen embrittlement mechanism and remedial measures-mechanism of differential aeration corrosion and remedial measures. Biological corrosion due to bacterial habitat, Combination of two dissimilar metal electrodes and relevant current-potential diagrams to evaluate corrosion rates-galvanic Corrosion.

UNIT-V

Combating Corrosion – Corrosion testing methods: Weight Loss methods, standard expression for corrosion rates-Huey Test, Streicher Test, Warren Test for corrosion. Linear Polarization Technique to evaluate corrosion, interpretation of corrosion data by Nelson's Method.

UNIT-VI

Corrosion Prevention Methods generally followed-Coatings, Organic (paints) and Inorganic coatings-Chemical Conversion coatings- Altering the environment, inhibitors organic and inorganic, altering or modifying the material, alloying essential design rules during fabrication and other precautions during the choice of the material for a given service environment.

UNIT-VII

Passivity, Anodic Protection and Cathodic Protection, Sacrificial anode Method –Current impressed Method- galvanizing of steel.

UNIT-VIII

Selection for a given Chemical Engineering Service Environment- Materials for Chemical Engineering Industry to resist the given chemical Environment.- Ferritic, Austenitic steels and stainless steels-Copper and its alloys-Brasses,

bronzes, Nickel and its alloys- Monel alloys-materials for a petroleum refinery industry.

TEXT BOOKS:

1. Fontana M.G, "Corrosion Engineering", Tata McGraw Hill, New York, 3 Ed, 2005.
2. Uhlig, H.H., "Corrosion and Corrosion Control" John Wiley & Sons, New York, 3 Ed, 1985.

SAFETY AND HAZARD ANALYSIS

(ELECTIVE-I)

Course Code: ACH1135

L	T	P	C
4	0	0	4

AIM:

To impart fundamental knowledge of safety requirements in Chemical industry.

OBJECTIVES:

These fundamentals will make students understand the safety concepts thoroughly and then apply accordingly.

UNIT-I

INTRODUCTION: Safety program, Engineering ethics, Accident and loss statistics, Acceptable risk, Public perception.

UNIT-II

TOXICOLOGY: How toxicants enter biological organisms, How toxicants are eliminated from biological organisms.

UNIT-III

INDUSTRIAL HYGIENE: Government regulations, Identification, Evaluation, Control.

UNIT-IV

FIRES AND EXPLOSIONS: The fire triangle, Distinction between fire and explosions; Definitions, Flammability characteristics of liquids and vapors, LOC and inerting, ignition energy, Auto ignition, Auto oxidation, Adiabatic compression, Explosions.

UNIT-V

DESIGNS TO PREVENT FIRES AND EXPLOSIONS: Inerting, Explosion proof equipment and instruments, Ventilations, Sprinkler systems.

UNIT-VI

INTRODUCTION TO RELIEFS: Relief concepts, Definitions, Location of reliefs, Relief types, Data for sizing reliefs, Relief systems.

UNIT-VII

RELIEF SIZING: Conventional spring operated relief's in liquids, Conventional spring operated relief's in vapor or gas service, Rupture disc relief's in liquid, vapour or gas service.

UNIT-VIII

HAZARDS IDENTIFICATION: Process hazards checklists, Hazard surveys, Hazop safety reviews.

TEXT BOOK:

Crowe, D.A.and Louvar, J.F. "Chemical Process Safety (Fundamentals with applications)", Prentice Hall ,1990.

REFERENCE:

1. Fawcet, H.H. and.Wood, W.S. "Safety and Accident Prevention in Chemical Operations", 2 Ed, John Wiley, New York 1982.
2. Sinnot, R.K. "Coulson and Richardson's , Chemical Engineering" Vol.6, Butterworth-Heinmann Limited 1996.

NON CONVENTIONAL SOURCES OF ENERGY

(ELECTIVE-I)

Course Code: AME1135

L	T	P	C
4	0	0	4

AIM:

To introduce and familiarize the student with the various renewable sources of energy.

OBJECTIVE:

Renewable sources of energy is an area of research and development especially for countries like India. So the student should be in a position to take up small scale projects, as entrepreneurs, since the cost of investment is minimal in some of the sources.

UNIT-I

Introduction to various renewable sources of energy.

SOLAR RADIATIONS: Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Solar radiation geometry, Longitude, Latitude, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Solar altitude angle expression for angle between incident beam and the normal to a plane surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

UNIT-II

SOLAR ENERGY: Solar thermal power and its conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing . Solar thermal energy storage, Different systems, Solar pond. Applications - Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants.

SOLAR PHOTOVOLTAIC SYSTEM: Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system.

UNIT-III

WIND ENERGY: Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, performance characteristics, Betz criteria Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent developments.

UNIT-IV

BIO-MASS AND BIO-GAS: Principles of Bio-Conversion, Photosynthesis, Bio gas production, Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India.

UNIT-V

OCEAN ENERGY: Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC.

TIDAL POWER: Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy, Limitations of tidal energy conversion systems.

UNIT-VI

GEOTHERMAL ENERGY: Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs,

Steam ejection, Principle of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion.

UNIT-VII

ELECTROCHEMICAL EFFECTS AND FUEL CELLS: Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages of fuel cell power plants, Future potential of fuel cells

HYDROGEN ENERGY: Properties of hydrogen in respect of its use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use.

UNIT-VIII

DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule-Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects.

TEXT BOOK:

Rai G.D, "Non-Conventional energy Sources", Khanna Publishers, 4 Ed, 2008.

REFERENCE:

Kothari D.P, "Renewable energy resources and emerging tech", Prentice Hall of India Pvt. Ltd, 1 Ed, 1990.

BIOMEDICAL INSTRUMENTATION

(ELECTIVE-I)

Course Code: AEC1130

L	T	P	C
4	0	0	4

AIM:

To give a complete exposure of various recording mechanisms and physiological parameters measured for diagnostic application.

OBJECTIVES:

- To study different types of electrodes used in bio-potential recording.
- To understand the characteristics of bio-amplifiers and different types of recorders.
- To understand how to measure various biochemical and nonelectrical parameters of human system.
- To study the instrumentation concerned with measuring the blood flow
- To study the latest developments in medical imaging systems.

UNIT-I

COMPONENTS OF MEDICAL INSTRUMENTATION SYSTEMS: Bio-amplifier, Static and dynamic characteristics of medical instruments. Bio-signals and characteristics. Problems encountered with measurements from human beings, Organization of cell, Nernst equation and Goldman's Equation for membrane Resting Potential Generation, Propagation of Action Potential,

UNIT-II

BIO-POTENTIAL ELECTRODES & TRANSDUCERS: Electrode potential, Electrode equivalent circuit, Types of Electrodes-Surface Electrodes, Needle Electrodes, Micro Electrodes. Transducers for measuring the physiological parameters

UNIT-III

BIO-SIGNAL ACQUISITION: Electrical Conduction system of the heart, ECG leads, Einthoven triangle, ECG amplifier, EEG 10-20 lead system, EEG amplifier, Specifications and Interpretation of ECG,EEG,EMG, ERG, EOG

UNIT-IV

BIO-SIGNAL MEASUREMENTS: Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter. Blood pressure measurement- Ultrasonic blood pressure monitoring. Phonocardiograph- Heart sound Microphone and preamplifier, TMT Machine.

UNIT-V

PHYSIOLOGICAL ASSIST DEVICES & THERAPEUTIC EQUIPMENT: Pacemakers- External & internal, Defibrillators- External & internal, Different types of Hemodialyser and Hemodialysis machine. Heart-Lung machine – Oxygenators and Blood pumps. Audio meter, Opthalmoscope, Shortwave Diathermy, Microwave Diathermy and Ultrasound Diathermy.

UNIT-VI

OPERATION THEATRE EQUIPMENT AND MONITORING EQUIPMENT: Spiro meter, Pnemuotachography using strain-gauge, Plethysmography, Anesthesia machine, Ventilators, Surgical diathermy, Humidifiers, Neubilisers. Arrthmia Monitor, Holter monitor, Ambulatory Monitor, Fotal Monitor, Incubator.

UNIT-VII

CLINICAL LABORATORY EQUIPMENT: Colorimeter, Flame photometer, Spectrophotometer, Conductivity meter, Electrophoresis, Chromatography, Blood cell Counter, Blood gas analyzer: pH-pCO_2, pO_2, Auto-analyzer, Glucometer.

UNIT-VIII

MEDICAL IMAGING EQUIPMENT: X-ray generation, X-ray tube, X-ray machine. Computed Tomography (CT), Endoscope, Ultrasound Imaging system, Magnetic resonance Imaging (MRI), Nuclear Imaging

systems- Positron Emission Tomography (PET), Single Photon Emission Tomography (SPECT)

TEXT BOOKS:

1. Cromwell L Weibell F.J., and Pfeiffer E.A., "Biomedical Instrumentation and Measurements", PHI, 2 Ed, 1980.
2. Webster J. G., "Medical Instrumentation, Application and Design", John Wiley, 3 Ed., 2009.
3. Arumugam M., "Biomedical Instrumentation", Anuradha Publications, 2 Ed., 1994.

REFERENCE:

R.S. Khandpur, "Hand-book of Biomedical Instrumentation", TMH, 2 Ed., 2003.

POLYMER ENGINEERING

(ELECTIVE-II)

Course Code: ACH1136

L	T	P	C
4	0	0	4

AIM:

The course introduces the student the basics of Polymer processing & Polymer technology.

OBJECTIVES:

This course teaches the student the various polymerization techniques and the desirable properties.

UNIT-I

INTRODUCTION : Defining Polymers, Classification of Polymers and Some Fundamental Concepts, Chemical Classification of Polymers Based on Polymerization Mechanisms, Molecular-weight Distributions, Configurations and Crystallinity of Polymeric Materials, Conformation of Polymer Molecules, Polymeric Supports in Organic Synthesis.

UNIT-II

EFFECT OF CHEMICAL STRUCTURE ON POLYMER PROPERTIES : Introduction, Effect of Temperature on Polymers, Additives for Plastics, Rubbers, Cellulose Plastics, Copolymers and blends, Cross-linking Reactions, Ion-Exchange Resins.

UNIT-III

STEP-GROWTH POLYMERIZATION: Introduction, Esterification of Homologous Series and the Equal Reactivity Hypothesis.

UNIT-IV

1) Chain-Growth Polymerization: Introduction, Radical Polymerization, Ionic Polymerization, Anionic Polymerization.
2) Emulsion Polymerization: Introduction, Aqueous Emulsifier Solutions.

UNIT-V

MEASUREMENT OF MOLECULAR WEIGHT AND ITS DISTRIBUTION: Introduction, End-Group Analysis, Colligative Properties, Light Scattering, Ultracentrifugation, Intrinsic Viscosity, Gel Permeation Chromatography.

UNIT-VI

THEORY OF RUBBER ELASTICITY: Introduction, Elastic Force Between Chain Ends, Stress-Strain Behavior, The Stress Tensor (Matrix), Measures of Finite Strain, The Stress Constitutive Equation, Vulcanization of Rubber and Swelling Equilibrium.

UNIT-VII

MECHANICAL PROPERTIES: Introduction, Stress-Strain Behavior, The Glass Transition Temperature, Dynamic Mechanical Experiments, Time-Temperature Superposition, Polymer Fracture, Crazing and Shear Yielding, Fatigue Failure, Improving Mechanical Properties.

UNIT-VIII

POLYMER PROCESSING: Introduction, Extrusion, Injection Molding and Fiber Spinning.

TEXT BOOK:

Anil Kumar, Gupta, R.K. "Fundamentals of Polymer Engineering", Marcel Dekker, 2 Ed, 2003.

PETROLEUM REFINING & PETROCHEMICALS

(ELECTIVE-II)

Course Code: ACH1137

L	T	P	C
4	0	0	4

AIM :

Crude refining is a major operation in the chemical industry . This course teaches the students the various aspects of refining.

OBJECTIVES:

Petroleum and petroleum refining is an important segment of energy and Petrochemical chemical products. This course adequately trains and equips the student in understand various refining problems and helps them to be abreast with basic aspects of petroleum refining and petrochemical products

UNIT-I

ORIGIN, FORMATION AND COMPOSITION OF PETROLEUM: Origin and formation of petroleum, Reserves and deposits of world, Indian Petroleum Industry.

UNIT-II

PETROLEUM PROCESSING DATA: Evaluation of petroleum, thermal properties of petroleum fractions, important products, properties and test methods.

UNIT-III

FRACTIONATION OF PETROLEUM: Dehydration and desalting of crudes, heating of crudepipe still heaters, distillation of petroleum, blending of gasoline.

UNIT-IV

TREATMENT TECHNIQUES: fraction-impurities, treatment of gasoline, treatment of kerosene, treatment of lubes.

UNIT-V

THERMAL AND CATALYTIC PROCESSES: Cracking, catalytic cracking, catalytic reforming, Naphtha cracking, coking, Hydrogenation processes, Alkylations processes, Isomerization process.

UNIT-VI

Petrochemical Industry – Feed stocks

UNIT-VII

CHEMICALS FROM METHANE: Introduction, production of Methanol, Formaldehyde, Ethylene glycol, PTFE, Methylamines.

UNIT-VIII

CHEMICALS FROM ETHANE-ETHYLENE-ACETYLENE: Oxidation of ethane, production of Ethylene, Manufacture of Vinyl Chloride monomer, vinyl Acetate manufacture, Ethanol from Ethylene, Acetylene manufacture, Acetaldehyde from Acetylene.

TEXT BOOKS:

1. Nelson, W.L. "Petroleum refining Engineering", Mc Graw Hill, New York, 4 Ed.1969.
2. Rao, B.K.B. "Modern Petroleum Refining Processes", Oxford and IBH Publishing 4 Ed, 2002.

REFERENCES:

1. Goldstine, R.F. "The Petroleum Chemicals Iindustry" , Taylor and Francis, London, 1967.
2. Gruese, W.S.and Stevens, D.R. " Chemical Technology of Petroleum" McGraw' Hill, 1980.
3. Chauvel, A. and Lefevrev, "Petro Chemicals" Volume 1 and 2 , Gulf Publishing company 1989.

ENERGY ENGINEERING

(ELECTIVE-II)

Course Code: ACH1138

L	T	P	C
4	0	0	4

AIM:

This course introduces the student the use of energy as a source of energy.

OBJECTIVES:

Energy plays as important role in human life and this course introduces the student the various forms of energy sources.

UNIT-I

Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with REFERENCE to India.

UNIT-II

Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

UNIT-III

Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.

UNIT-IV

Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel., fuel cells, flue gas, analysis: Orsat apparatus,

UNIT-V

ENERGY AUDITING: short term, medium term, long term schemes,

energy conversion, energy index, energy cost, representation of energy consumption, sanky diagram, energy auditing.

UNIT-VI
BATTERIES:

Fundamentals:

EMF, reversible cells and irreversible cells, reversible electrodes, relationship between electrical energy and energy content of a cell, free energy changes and emf in cells, relationship between the energy changes accompanying a cell reaction and concentration of the reactants, effect of cell temperature on batteries, derivation of number of electrons involved in a cell reactions, thermodynamic calculation of the capacity of a battery, calculations of energy density of cells, heating effects in batteries, spontaneous reaction in electrochemical cells, pressure development in sealed batteries.

(i) Factors affecting battery performance :

Factors affecting battery capacity, voltage level current drain of discharge, types of

Discharge continuous, intermittent, constant current, constant load, constant power, service life, voltage regulation, changing methods, battery age & storage condition, effect of battery design.

(ii) Testing of battery components:

Evaluation of active masses, porosity - mercury porosity meter, liquid absorption method, surface area measurement - BET method (nitrogen absorption.), internal resistance of cells - D.C. methods, polarization elimination method. I.E. polarization and flash current method A.C. methods, A.C. impedance method, testing of storage batteries

Storage Batteries

Principle design construction, advantage and disadvantages.

Primary batteries - Zn-MnO2 system, carbon-zinc and carbon-zinc chlorides performance characteristics and zinc-silver oxide.

Reserve batteries: seawater activated batteries, thermal batteries, electrolyte activated batteries

Secondary batteries – lead acid, nickel cadmium, nickel metal hydride, silver oxide zinc system, lithium ion, Lithium polymer

Batteries for Defense applications:

(i)Army – Lithium based primary batteries

(ii)Air force- Silver zinc, nickel cadmium, batteries used in UAV

(iii) Navy- batteries for Torpedo, mines, Decoys, AUV, submarine etc.

Fuel cells & Super capacitor:

Introduction to super capacitors, types of super capacitors, introduction to fuel cells, types of fuel cells and technology development Testing and Evaluation of high energy & power batteries capacity test -test for retention of charge, vibration test, life test, efficiency test, leakage test for sealed cells, testing of separators, HRD at normal and low temperature

UNIT -VII

FUEL CELLS: What is a fuel cell, Types of fuel cells, fuel cells applications, main components of a PEM fuel cell.

UNIT -VIII

ENERGY CONSERVATION: conservation methods in process industries, theoretical analysis, practical limitations.

TEXT BOOKS:

1. Gupta, O.P. "Fuels, Furnaces and Refractories", Khanna Publishers,NewDelhi,1990.
2. Samir Sarkar, "Fuels and Combustion", Orient Longman, 2 Ed ,1998.
3. Linden D and Reddy T.B., " Hand book on batteries and Fuel cells", McGraw Hill Book Co., New York, 3 Ed., 2002.
4. Frano B., "PEM fuel cells: Theory and practice", Elsevier, 2005.

REFERENCES:

1. Rai, G.D. "Non-Conventional Energy Resources", Khanna Publsihers, New Delhi, 1993.

2. Sukhathme , S.P. “Solar Energy”. , Tata Mc Graw Hill, New Delhi, 1996.
3. Murphy, W.R., Mc.Kay, G. “Energy Management”, Butterworth, 1 Ed, 2000.

DATA STRUCTURES FOR ENGINEERING APPLICATIONS

(ELECTIVE- II)

Prerequisite: Computer Programming through C

Course Code: AIT1114

L	T	P	C
4	1	0	4

AIM:

To empower students to build efficient software applications with suitable data structures.

OBJECTIVE:

To make students understand the software design techniques for solving engineering applications of their discipline

UNIT-I

RECURSION AND LINEAR SEARCH : Preliminaries of algorithm, Algorithm analysis and complexity, Recursion: Definition, Design Methodology and Implementation of recursive algorithms, Linear and binary recursion, recursive algorithms for factorial function, GCD computation, Fibonacci sequence, Towers of Hanoi.

Chapters 1, 2 from Text Book 1

UNIT-II

SEARCHING TECHNIQUES : Introduction, Linear Search, Transpose Sequential, Search, Interpolation Search, Binary Search, Fibonacci Search.

Chapter 15 from Text Book 2.

UNIT-III

SORTING TECHNIQUES : Basic concepts, insertion sort, selection sort, bubble sort, quick sort, merge sort.

Chapter 12 from Text Book 1

UNIT-IV

STACKS : Basic Stack Operations, Representation of a Stack using Arrays, Stack Applications: Reversing list, Factorial Calculation, In-fix-to postfix Transformation, Evaluating Arithmetic Expressions.

Chapter 3 from Text Book 1.

UNIT-V

QUEUES : Basic Queues Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack.

Chapter 4 from Text Book 1.

UNIT-VI

APPLICATIONS OF QUEUES : Applications of Queues- Enqueue, Dequeue, Circular Queues, Priority Queues.

Chapter 4 from Text Book 1.

UNIT-VII

LINKED LISTS : Introduction, single linked list, representation of a linked list in memory, Operations on a single linked list, merging two single linked lists into one list, Reversing a single linked list, Circular linked list, Double linked list.

Chapter 6 from Text Book 2.

UNIT-VIII

TREES : Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays and linked lists, operations on a Binary tree , Binary Tree Traversals (recursive), Creation of binary tree from in-order and pre(post)order traversals.

Chapter 8 from Text Book 2.

TEXT BOOKS:

1. Richard F, Gilberg & Behrouz A. Forouzan, " Data Structures", 2nd Edition, Thomson, 2007.
2. GAV PAI, "Data Structures and Algorithms", 1st Edition, Tata McGraw-Hill, 2010.

REFERENCES:

1. Seymour Lipschutz, "Data Structure with C", 1st Edition, TMH, 2009.
2. Debasis ,Samanta "Classic Data Structures", 2nd Edition, PHI,2009
3. Horowitz,Sahni, Anderson "Fundamentals of Data Structure in C", 2nd Edition, Freed, University Press, 2009.

Note

A small application may be implemented in software from their respective disciplines at the end of the course.

SOFTWARE DEVELOPMENT ENGINEERING

(ELECTIVE-II)

Course Code: ACS1115

L	T	P	C
4	0	0	4

AIM :

- To provide an understanding of the various processes software engineers may employ in developing contemporary software systems
- To examine all phases of the software development life cycle, from initial planning through implementation and maintenance.
- To develop an understanding of the tools and Techniques employed in contemporary Software engineering.

OBJECTIVES:

- To demonstrate the skills required to analyze, design for software systems.
- To demonstrate an appreciation of good practices in software engineering.
- To demonstrate the application of software quality concepts.

UNIT-I

INTRODUCTION TO SOFTWARE ENGINEERING : The evolving role of software, Changing Nature of Software, Software Myths.

A GENERIC VIEW OF PROCESS: SOFTWARE ENGINEERING – A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), process patterns, process assessment, personal and team process models.

UNIT-II

PROCESS MODELS : The waterfall model, Incremental process models, Evolutionary process Models, The Unified process, agile methodology.

SOFTWARE REQUIREMENTS: Functional and non-functional requirements, user requirements, System requirements, Interface specification, the Software Requirements document.

UNIT-III

REQUIREMENTS ENGINEERING PROCESS: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

SYSTEM MODELS: context models, Behavioral models, Data models, object models, structured Methods.

UNIT-IV

DESIGN ENGINEERING: Design process and Design quality, Design concepts, the design model.

CREATING AN ARCHITECTURAL DESIGN: Software Architecture, Data design, Architectural styles and Patterns, Architectural Design.

UNIT-V

OBJECT ORIENTED DESIGN: Objects and Object classes, An Object Oriented design process, Design Evolution.

PERFORMING USER INTERFACE DESIGN: Golden rules, User interface analysis and design, interface Analysis, interface design steps, Design evaluation,

UNIT-VI

TESTING STRATEGIES: A strategic approach to software testing, the strategies for conventional

Software, Verification Testing and Validation Testing, Different Types of Testing, the art of Debugging.

UNIT-VII

Client Server Systems - Meaning, Architecture and Design

Web based Systems - Meaning, Architecture and Design

Data warehouse System - Meaning, Architecture and Design

Introduction to RAD Tool (3-4 lab sessions included)

UNIT-VIII

Write Software Development Specifications that include System Analysis and System design for

a) A Web Based Application System

b) A Data warehouse Application system

TEXT BOOKS:

1. Pressman R.S "Software Engineering, A Practitioner's Approach", TMH, 7 Ed, 2008.

2. Han J and Kamber M "Data Mining – Concepts and Techniques", Morgankaufmann Publishers, 2 Ed, 2008.

COMPUTER AIDED DESIGN OF CHEMICAL EQUIPMENT LAB

Course Code: ACH1139

L	T	P	C
0	0	3	2

1) Design of a double pipe Heat Exchanger.
2) Design of a 1-2 shell & tube Heat Exchanger.
3) Design of a Evaporator.
4) Design of a Distillation Column
5) Process simulation of absorber, Distillation Column, LLE columns using PRO-II. Inclusion of Tray efficiencies, Side streams, Interchange Heaters & coolers.

APPLICATIONS OF MATLAB IN CHEMICAL ENGINEERING

Course Code: ACH1140

L	T	P	C
0	0	3	2

1) Basics of MATLAB: Matrices and vector manipulation, calculating inverse and eigen values and eigen vectores of a matrix.
2) Linear Regression, Non- linear Regression.
3) Non-linear Algebraic Equations: Solving CSTR: isothermal & non-isothermal case, Bioreactor model and calculating multiple steady states.
4) ODE-IVP
   - Batch reactor, PFR
5) ODE-BVP
   - Tubular Reactors with Axial diffusion, Heat transfer in a fin, effectiveness factor calculation.
6) Control systems: Defining a transfer function, calculating poles and zeros of a transfer function.
7) Step and pulse response of a given transfer function.
8) Inverse Response and its limitations in controller setting.
9) Design a feedback PID controller by simulations for a given transfer function.

COURSE STRUCTURE & SYLLABI FOR VIII SEMESTER

VIII SEMESTER

COURSE CODE	THEORY/LAB	L	T	P	C
ACH1141	Optimization Of Chemical Processes	4	0	0	4
	Elective-III	4	0	0	4
ACH1142	Biological Waste Water Treatment				
ACH1143	Computational Fluid Dynamics				
ACH1144	Green Chemical Engineering				
AEC1142	Process Control and Automation				
	Elective-IV	4	0	0	4
ACH1145	Instrumentation Methods				
ACH1146	Down Stream Processing In Bio processing				
ACH1147	Nano Technology				
ACH1148	Optimization Techniques				
ACH11SM	Seminar	0	0	3	2
ACH11CV	Comprehensive Viva	-	-	-	4
ACH11PW	Project Work	0	0	9	12
Total		**12**	**0**	**12**	**30**

OPTIMIZATION OF CHEMICAL PROCESSES

Course Code: ACH1141

L	T	P	C
4	0	0	4

AIM:

To provide the overview of concepts and methods of single and multi-variable optimization.

OBJECTIVE:

To solve general and chemical engineering single and multi-variable optimization Problems.

The following syllabus is limited to Multi-variable problems with two variables only.

UNIT-I

Gradient of a single variable function, gradient vector of a multi-variable function, second derivative of a single variable function, Hessian of a multi-variable function, Eigen values of a matrix, convex functions, determination of convexity of a function by Eigen values.

UNIT-II

Optimality conditions for a single-variable and multi-variable functions, classification of stationary points for single-variable and multi-variable functions.

UNIT-III

Structure of a single-variable and multi-variable optimization problems with and without constraints (qualitative treatment), single-variable optimization methods and problems: interval halving method, golden section method and Fibanocci method.

UNIT-IV

Multi-variable optimization without constraints: Multi-variable optimization methods, such as steepest descent, Newton's method and unidirectional search method. Solving two-variable optimization problems using above methods.

UNIT-V

Multi-variable optimization with constraints: Lagrangian multiplier method, Karush-Kuhn-Tucker (KKT) conditions, penalty function method. Solving two-variable constrained optimization problems using above methods.

UNIT-VI

Linear programming, Simplex method to solve LP problems, duality principle and converting a LP to dual LP.

UNIT-VII

Chemical engineering optimization problems

Part 1: Pipe diameter, multi-stage evaporator, reflux ratio of distillation column.

UNIT-VIII

Chemical engineering optimization problems

Part 2: Thermal cracker, Alkylation reactor.

TEXT BOOKS:

1. Edgar,T.F., Himmelblau, D.M. and Lasdon L.S., "Optimization of Chemical Processes", McGraw-Hill International, 2 Ed, 2001.
2. Kalyanmoy Deb "Optimization for Engineering Design", Prentice Hall,India, 2005.
3. Rao S.S., "Engineering Optimization-Theory & Practice", New Age International Publishers, New Delhi, 3 Ed, 1996.

REFERENCES:

1. Arora J.S., "Introduction to Optimum Design", Elsevier Academic Press, San Diego, USA., 2 Ed, 2004.
2. Reklaitis, G.V., Ravindran, A., and Ragsdell, K.M., "Engineering Optimization-Methods and Applications", Wiley., New York, 2 Ed, 1983.

BIOLOGICAL WASTE WATER TREATMENT

(ELECTIVE-III)

Course Code: ACH1142

L	T	P	C
4	0	0	4

AIM :

To impart knowledge on biological methods of waste treatment.

OBJECTIVES:

To understand and help remove different chemicals from waste water generated from various chemical industrial by biological means

UNIT-I

HISTORICAL DEVELOPMENT OF WASTEWATER COLLECTION AND TREATMENT: Water Supply and Wastewater Management in Antiquity, Water Supply and Wastewater Management in the Medieval Age, First Studies in Microbiology, Wastewater Management by Direct Discharge into Soil and Bodies of Water – The First Studies ,Mineralization of Organics in Rivers, Soils or by Experiment –A Chemical or Biological Process?, Early Biological Wastewater Treatment Processes, The Cholera Epidemics – Were They Caused by Bacteria Living in the Soil or Water?, Early Experiments with the Activated Sludge Process, Taking Samples and Measuring Pollutants, Early Regulations for the Control of Wastewater Discharge.

WASTEWATER CHARACTERIZATION AND REGULATIONS: Volumetric Wastewater Production and Daily Changes, Pollutants, Survey, Dissolved Substances, Organic Substances, Inorganic Substances, Colloids, Oil-In-Water Emulsions, Solid-In-Water Colloids, Suspended Solids, Methods for Measuring Dissolved Organic Substances as Total Parameters, Biochemical Oxygen Demand, Chemical Oxygen Demand, Total and Dissolved Organic Carbon.

UNIT-II

MICROBIAL METABOLISM: Some Remarks on the Composition and Morphology of Bacteria (Eubacteria),Proteins and Nucleic Acids,

Proteins , Amino Acids , Structure of Proteins, Proteins for Special Purposes , Enzymes, Nucleic Acids, Desoxyribonucleic Acid, Ribonucleic Acid, DNA Replication, Mutations, Catabolism and Anabolism, ADP and ATP, Transport of Protons, Catabolism of Using Glucose, Aerobic Conversion by Prokaryotic Cells, Anaerobic Conversion by Prokaryotic Cells,Anabolism.

DETERMINATION OF STOICHIOMETRIC EQUATIONS FOR CATABOLISM AND ANABOLISM: Introduction ,Aerobic Degradation of Organic Substances , Degradation of Hydrocarbons Without Bacterial Decay, Mineralization of 2,4-Dinitrophenol , Degradation of Hydrocarbons with Bacterial Decay, Measurement of O_2 Consumption Rate r O_2,S and CO_2 Production.

UNIT-III

GAS/LIQUID OXYGEN TRANSFER AND STRIPPING: Transport by Diffusion, Mass Transfer Coefficients, Definition of Specific Mass Transfer Coefficients , Two Film Theory, Measurement of Specific Overall Mass Transfer Coefficients KLa ,Absorption of Oxygen During Aeration, Steady State Method , Non-steady State Method , Dynamic Method in Wastewater Mixed with Activated Sludge , Desorption of Volatile Components During Aeration, Oxygen Transfer Rate, Energy Consumption and Efficiency in Large-scale Plants, Surface Aeration, Oxygen Transfer Rate , Power Consumption and Efficiency.

UNIT-IV

AEROBIC WASTEWATER TREATMENT IN ACTIVATED SLUDGE SYSTEMS: Introduction, Kinetic and Reaction Engineering Models With and Without Oxygen Limitation, Batch Reactors, With High Initial Concentration of Bacteria, With Low Initial Concentration of Bacteria, Chemostat, Completely Mixed Activated Sludge Reactor, Preliminary Remarks ,Mean Retention Time, Recycle Ratio and Thickening Ratio as Process Parameters, Sludge Age as Parameter, Plug Flow Reactor , Completely Mixed Tank Cascades With Sludge Recycle , Flow Reactor With Axial Dispersion ,Stoichiometric and Kinetic Coefficients ,Comparison of Reactors, Retention Time Distribution in Activated Sludge Reactors, Retention Time Distribution, Completely Mixed Tank, Completely Mixed Tank Cascade, Tube Flow Reactor With Axial Dispersion, Comparison

Between Tank Cascades and Tube Flow Reactors , Technical Scale Activated Sludge Systems for Carbon Removal.

UNIT-V

AEROBIC TREATMENT WITH BIOFILM SYSTEMS: Biofilms, Biofilm Reactors for Wastewater Treatment , Trickling Filters, Submerged and Aerated Fixed Bed Reactors , Rotating Disc Reactors, Mechanisms for Oxygen Mass Transfer in Biofilm Systems , Models for Oxygen Mass Transfer Rates in Biofilm Systems, Assumptions, Mass Transfer Gas/ Liquid is Rate-limiting ,Mass Transfer Liquid/Solid is Rate-limiting , Biological Reaction is Rate-limiting, Diffusion and Reaction Inside the Biofilm ,Influence of Diffusion and Reaction Inside the Biofilm and of Mass Transfer Liquid/Solid , Influence of Mass Transfer Rates at Gas Bubble and Biofilm.

UNIT-VI

ANAEROBIC DEGRADATION OF ORGANICS: Catabolic Reactions – Cooperation of Different Groups of Bacteria, Survey, Anaerobic Bacteria , Acidogenic Bacteria, Acetogenic Bacteria, Methanogenic Bacteria, Regulation of Acetogenics by Methanogenics, Sulfate and Nitrate Reduction, Kinetics – Models and Coefficients ,Preface, Hydrolysis and Formation of Lower Fatty Acids by Acidogenic Bacteria, Transformation of Lower Fatty Acids by Acetogenic Bacteria, Transformation of Acetate and Hydrogen into Methane, Conclusions, Catabolism and Anabolism ,High-rate Processes , Introduction,Contact Processes, Upflow Anaerobic Sludge Blanket , Anaerobic Fixed Bed Reactor ,Anaerobic Rotating Disc Reactor , Anaerobic Expanded and Fluidized Bed Reactors.

UNIT-VII

BIODEGRADATION OF SPECIAL ORGANIC COMPOUNDS

Introduction, Chlorinated Compounds , Chlorinated n-Alkanes, Particularly Dichloromethane and1,2-Dichloroethane , Properties, Use, Environmental Problems and Kinetics , Treatment of Wastewater Containing DCM or DCA , Chlorobenzene , Properties, Use and Environmental Problems , Principles of Biological Degradation , Treatment of Wastewater Containing Chlorobenzenes ,Chlorophenols , Nitroaromatics ,Properties, Use, Environmental Problems and Kinetics ,Treatment of Wastewater Containing

4-NP or 2,4-DNT , Polycyclic Aromatic Hydrocarbons and Mineral Oils, Properties, Use and Environmental Problems, Mineral Oils, Biodegradation of PAHs , PAHs Dissolved in Water, PAHs Dissolved in n-Dodecane Standard Emulsion , Azo Reactive Dyes, Properties, Use and Environmental Problems ,Production of Azo Dyes in the Chemical Industry – Biodegradability of Naphthalene Sulfonic Acids, Biodegradation of Azo Dyes ,Direct Aerobic Degradation, Anaerobic Reduction of Azo Dyes, Aerobic Degradation of Metabolites, Treatment of Wastewater Containing the Azo Dye Reactive Black.

UNIT-VIII

BIOLOGICAL NUTRIENT REMOVAL: Introduction, Biological Nitrogen Removal , The Nitrogen Cycle and the Technical Removal Process, Nitrification , Nitrifying Bacteria and Stoichiometry, Stoichiometry and Kinetics of Nitrification, Parameters Influencing Nitrification ,Denitrification , Denitrifying Bacteria and Stoichiometry, Stoichiometry and Kinetics of Denitrification ,Parameters Influencing Denitrification ,Nitrite Accumulation During Nitrification , New Microbial Processes for Nitrogen Removal ,Biological Phosphorus Removal , Enhanced Biological Phosphorus Removal Kinetic Model for Biological Phosphorus Removal , Preliminary Remarks , Anaerobic Zone , Aerobic Zone, Results of a Batch Experiment , Parameters Affecting Biological Phosphorus Removal ,Biological Nutrient Removal Processes, Nitrogen Removal Processes, Chemical and Biological Phosphorus Removal, Processes for Nitrogen and Phosphorus Removal, Different Levels of Performance , WWTP Waßmannsdorf ,Membrane Bioreactors (MBR) , Phosphorus and Nitrogen Recycle, Recycling of Phosphorus, Recycling of Nitrogen.

TEXT BOOKS:

Weismann, U., Dombrovski, E.M., "Fundamentals of Biological Water Treatment" , Wiley- VCH, Federal Republic of Germany, 2007.

COMPUTATIONAL FLUID DYNAMICS

(ELECTIVE-III)

Course Code: ACH1143

L	T	P	C
4	0	0	4

AIM:

Computational Fluid Dynamics is emerging as one of the most useful techniques to understand the nature of flow in varying flow systems. To make the student in tune to the recent development, this course would be helpful

OBJECTIVES:

This course teaches the student the introductory and numerical aspects of CFD.

UNIT-I

INTRODUCTION TO DIFFERENCING SCHEMES: Basics of Finite difference methods, finite element method and finite volume method. CFD Applications.

UNIT-II

Final Governing differential equations of CFD and boundary conditions in Cartesian, cylindrical and spherical co-ordinate systems.

UNIT-III

FINITE DIFFERENCE METHODS FOR DIFFUSION PROBLEMS(THEORY): Explicit Method and its Stability criteria, Implicit Method, Crank Nicholson method, Use of one Sided FDM to handle boundary conditions.

UNIT-IV

FINITE DIFFERENCE METHODS FOR STEADY STATE CONVECTION- DIFFUSION PROBLEMS (THEORY): Use and importance of Upwinding difference method.

UNIT-V

FINITE VOLUME METHOD FOR STEADY SATE DIFFUSION (THEORY): One dimensional and two dimensional problems.

UNIT-VI

FINITE VOLUME METHOD FOR STEADY STATE CONVECTION-DIFFUSION PROBLEMS (THEORY): One dimensional and two dimensional problems**.** Use and importance of Upwinding difference method, Hybrid method and Power Law method.

UNIT-VII

CASE STUDY-1 : Using FDM and FVM for solving steady and un-steady state one dimensional diffusive problem.

UNIT-VIII

CASE STUDY-2 : Using FDM and FVM for solving one and two dimensional convection and diffusion problem.

TEXT BOOKS:

1. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", Taylor and Francis, 1980.
2. Versteeg, H.K., and Malalasekera W, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method" , Longman, 1998.

REFERENCE:

1. Muralidhar.K and Sundarajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi 1995.

GREEN CHEMICAL ENGINEERING

(ELECTIVE-III)

Course Code: ACH1144

L	T	P	C
4	0	0	4

AIM:

The challenge for Chemists and Chemical engineers is to develop new methods for product manufacture that minimizes material and energy.

OBJECTIVES:

After reading this course the student would be able to

- The importance of green chemistry.
- Sustainable development.
- Some technologies that have minimized the material and energy usage.

UNIT-I

PRINCIPLES OF SUSTAINABLE AND GREEN CHEMISTRY

- Green Chemistry and Industry
- Waste Minimization
- Reduction of Material Use
- Reduction of Energy requirements
- Reduction of Risk and Hazard
- Concept of Sustainability
- Green Chemistry and Sustainability Parameters.

UNIT-II

LIFE CYCLE ASSESSMENT: TOOL FOR IDENTIFICATION OF MORE SUSTAINABLE PRODUCTS AND PROCESSES

- Life Cycle Methodology.
- Application of Life Cycle assessment.

UNIT-III
INDUSTRIAL PROCESSES USING SOLID ACID CATALYSTS

- Concept of Acidity and solid acid catalyst
- Industrial application of solid acid catalysts
- Recent developments in Catalytic materials and processes

UNIT-IV
MICELLE- TEMPLATED SILICA AS CATALYSTS IN GREEN CHEMISTRY

- Mesoporous materials : introduction
- Catalytic applications : Oxidation Reactions like epoxidation, metal free epoxidation, arene hydroxylation, alkane oxidation, and base catalysis(other than oxidation)

UNIT-V
POLYMER SUPPORTED REAGENTS FOR ORGANIC SYNTHESIS

- Polymeric tools for organic synthesis: Polymeric reagents, Polymeric carriers, polymeric catalysts.
- Synthesis with polymer supported reagents
- Acids Chlorides and Anhydrides
- Alcohols, Aldehydes, Ketones, Amides, amines, azodyes, carbodiamides, epoxides, esters, ethers, fluoro derivatives etc

UNIT-VI
BIO CATALYSIS:

- Chemical Production using biocatalysis: bulk chemicals, Pharmaceuticals, Flavours and fragrance, Carbohydrates, polymers
- Green Biocatalytic processes: Biocatalysis in waste treatment and hydro-desulfurization

UNIT-VII

PROCESS INTENSIFICATION IN GREEN CHEMISTRY:

- Spinning Disc reactor, Micro reactors, Intensified cross-corrugated multifunctional membrane

UNIT-VIII

Application of Sonochemistry, Microwave irradiation, electrochemistry and photochemistry in Green Chemistry

TEXT BOOK:

1. Clark.J., and Macquarie,D. (editors), "Handbook of Green Chemistry and Technology", Blackwell Science, Oxford, 2002.
2. Allen, D. T. and Shonnard, D. R., "Green Engineering: Environmentally Conscious Design of Chemical Processes", Prentice Hall, New Jersey, 2001.

PROCESS CONTROL AND AUTOMATION

(ELECTIVE-III)

Course Code: AEC1142

L	T	P	C
4	0	0	4

AIM:

To familiarize engineers of all disciplines with the knowledge of computers and electronics.

OBJECTIVE:

1. To make a student comprehensive Engineer.
2. To make the student understand the importance of automation and control for imrovement of quality and productivity.
3. This knowledge should make every engineer to undrstand the importance of proper specifications to be defined for making the automation successful.

UNIT-I

INTRODUCTION TO COMPUTER CONTROL : Role of computers in the control of Industrial processes (plants). Elements of Computer Controlled Process / Plant. Classification – Batch, Continuous, Supervisory and Direct Digital Controls. Architecture – Centralized, Distributed and Hierarchical Systems. Man Machine or Human Computer Interface (HCI).

UNIT-II

BUILDING BLOCKS : Process Control Requirements of Computers. Process related variables. Computer Network. Communications in Distributed control Systems. Smart Sensors and Field bus.

UNIT-III

CONTROL SYSTEM DESIGN : Control System Design – Heuristics, Structural Controllability and Relative Gain Array. Controller Design – Regulator design and other design considerations. Controller Tuning – P,

PI, PID, and Ziegler-Nicholas method. Computer aided Control System Design.

UNIT-IV

PROGRAMMABLE LOGIC CONTROLLERS (PLCS) : Introduction - principles of operation - Architecture of Programmable Logic controllers - programming the programmable controllers- software - configurations - applications.

UNIT-V

DESIGN OF FEED FORWARD CONTROLLER : Block Diagram, Feed Forward control algorithms – dynamic, static, Deadbeat

UNIT-VI

CASCADE, PREDICTIVE AND ADAPTIVE CONTROL : Cascade Control – Dynamic response, Types, Implementation. Predictive Control – Model based and Multivariable System. Adaptive Control – Adjustment, Schemes, and Techniques.

UNIT-VII

INDUSTRIAL CONTROL APPLICATIONS : Automation of thermal power plant - Automation strategy - distributed system structure - Automatic boiler controller - diagnostic function and protection - - automatic start-up system - thermal stress control - man - machine interface – software system - communication system - variable pressure control - combined plant control.

UNIT-VIII

DISTRIBUTED CONTROL SYSTEMS : Introduction - Functional requirements of distributed control system - system architecture -

Distributed control systems - configuration - Applications of distributed control systems.

TEXT BOOKS

1. Singh S.K. " Computer Aided Process Control", PHI Learning Pvt. Ltd., 2004
2. Chidambaram M., "Computer Control of Processes ", Narosa, 2003.

REFERENCES:

1. Seborg, D.E., Edgar T.F., and Mellichamp D.A., "Process Dynamics and Control", John Wiley, 2004.
2. Curtis J.D, "Instrumentation Technology", Prentice Hall India, 7 Ed, 2002.
3. Krishna Kanth, "Computer-based Industrial Control", PHI, 1997.
4. Bennett S. "Real Time Control : An Introduction" Pearson Education India, 2 Ed, 2003.

INSTRUMENTATION METHODS

(ELECTIVE-IV)

Course Code: ACH1145

L	T	P	C
4	0	0	4

AIM:

To make the student understand the advanced instrumentation available for chemical analysis

OBJECTIVES:

After studying this course the student would be able to choose the instrument needed for analysis.

UNIT-I

AN INTRODUCTION TO INSTRUMENTAL METHODS : Terms Associated With Chemical Analysis, Classification Of Instrumental Techniques, A Review Of The Important Considerations In Analytical Methods, Basic Functions of Instrumentation, Important Considerations in Evaluating an Instrumental Method.

MEASUREMENTS, SIGNALS AND DATA : Introduction, Signal-to-Noise Ratio, Sensitivity and Detection Methods, Source of Noise, Hardware Techniques for Signal-to-Noise Enhancement, Software Techniques for Signal-to-Noise Enhancement, Evaluation of Results, Accuracy and Instrument Calibration, Chemometrics.

UNIT-II

AN INTRODUCTION TO ABSORPTION AND EMISSION SPECTROSCOPY : The Nature of Electromagnetic Radiation, The Electromagnetic Spectrum, Atomic Energy Levels, Molecular Electronic Energy Levels, Vibrational Energy Levels, Raman Effect, Lasers, Nuclear Spin Behaviour, Electron Spin Behaviour.

UNIT-III

ULTRAVIOLET AND VISIBLE SPECTROMETRY-INSTRUMENTATION : Radiation Sources, Wave Length Selection, Cells And Sampling Devices, Detectors, Instruments for Absorption Photometry.

ULTRAVIOLET AND VISIBLE ABSORPTION METHODS : Fundamental Laws of Photometry, Spectrophotometric Accuracy, Photometric Precision, Quantitative Methodology, Differential or Expanded-Scale Spectroscopy.

UNIT-IV

FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY : Introduction, Instrumentation for Flame Spectrometric Methods, Flame Emission Spectrometry, Atomic Absorption Spectrometry, Interference Associated with Flame and Furnaces, Applications, Comparision of FES and AAS.

UNIT-V

INFRARED SPECTROMETRY : Correlation of Infrared Spectra with Molecular Structure, Instrumentation, Sample Handling.

RAMAN SPECTROSCOPY : Theroy, Instrumentation, Sample Handling and Illumination, Structural Analysis, Comparision of Raman with Infrared Spectroscopy.

UNIT-VI

MASS SPECTROMETRY : Sample Flow in a Mass Spectrometer, Inlet Sample System, Ionization Methods in Mass Spectrometry, Mass Analyzers, Ion-Collection System, Vacuum System, Isotope- Ratio Spectrometry, Correlation of Mass Spectra With Molecular Structure.

UNIT-VII

CHROMATOGRAPHY: GENERAL PRINCIPLES : Classification of Chromatographic Methods, Chromatographic Behaviour of Solutes, Column Efficiency and Resolution, Column Processes and Band Broadening, Time of Analysis and Resolution, Quantitative Determinations.

GAS CHROMATOGRAPHY : Gas Chromatographs, Derivative Formation, Gas Chromatographic Columns, Liquid Phases and Column Selection, Detectors for Gas Chromatography.

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY: HPLC Instrumentation, Mobile-Phase Delivery System, Sample Introduction, Separation Columns, Detectors.

UNIT-VIII

THERMAL ANALYSIS : Thermogravimetry, Evolved Gas Detection and Analysis, Methodology of Thermogravimetry, Differential Scanning Calorimetry and Differential Thermal Analysis.

X RAY DIFFRACTION : General Principles, Braggs equation, Laue photographic method, Rotating crystal method, Oscillating crystal method, Powder method, Interpretation of the Diffraction pattern, Applications of XRD.

TEXT BOOK:

Willard, H.H, Merritt, L.L, Dean, J.A, and Settle, F.A, "Instrumental methods of analysis" CBS Publishers & Distributors, 7 Ed, 1986.

REFERENCES:

1. Srivastava, A.K. and. Jain, P.C, "Instrumental Approach to Chemical Analysis", S Chand and Company Ltd, New Delhi, 4 Ed, 2012.
2. Chatwal, G. R., Anand, Sham K., "Instrumental Methods of Chemical Analysis" Himalaya Publishing House, 5 Ed, 2005.

DOWNSTREAM PROCESSING IN BIOPROCESSING

(ELECTIVE-IV)

Course Code: ACH1146

L	T	P	C
4	0	0	4

AIM:

To learn separation and purification processes in Biochemical Engineering.

OBJECTIVE:

To study different separation processes in the purification of biochemical engineering qualitatively.

UNIT-I

Introduction to bio separations, Filtration and Micro filtration: - Equipment for Conventional Filtration, Pretreatment, General Theory for Filtration, Continuous Rotary Filters, Micro filtration.

UNIT-II

Centrifugation, settling of solids, Centrifuges, Centrifugal filtration, Scale-Up of Centrifugation.

UNIT-III

Cell Disruption: - Cell membranes, Chemical Methods, Mechanical Disruption.

UNIT-IV

Extraction: - The chemistry of extraction, Batch extraction, Staged Extraction, Differential extraction, Fractional Extractions with stationary phase and Fractional Extractions with two moving phases.

UNIT-V

Adsorption: - The chemistry of adsorption, Batch adsorption, Adsorption in a continuous stirred tank, Adsorption in fixed beds.

UNIT-VI

Elution Chromatography: - Adsorbents yield and purity, Discrete stage analysis, Kinetic analysis, Precipitation with a non solvent, Precipitation with salts, Precipitation with temperature change, Large Scale precipitation.

UNIT-VI

Ultra filtration and Electrophoresis: - Basic ideas, Ultrafiltration, Electrophoresis, Electro dialysis and Isoelectric Focusing.

UNIT-VIII

Crystallization : Basic concepts, crystal Size Distribution, Batch crystallization, Recrystalization.Drying: - Basic concepts, Drying Equipment, Conduction Drying, Adiabatic Drying.

TEXT BOOK:

Better P. A., Cussler E. L.,Wei-Shou Hu,A, "Downstream Processing for Biotechnology", Wiley- Interscience Publication, 1988.

NANO TECHNOLOGY

(ELECTIVE-IV)

Course Code: ACH1147

L	T	P	C
4	0	0	4

AIM:

This course introduces the student the basic knowledge of Nano Technology.

OBJECTIVES:

After studying the course the student will be able to know

- Properties that make nano materials.
- How nano materials are produced and characterized.
- Where nano materials are used.

UNIT-I

Introduction to Nano Technology, Carbon NanoTubes (CNTs), Porous Silicon, Aerogels, Zeolites, Ordered Porous Materials Using Micelles as Templates, Self Assembled Nanomaterials, Core- Shell Particles.

UNIT-II

STRUCTURE AND BONDING: Arrangement of Atoms, Two Dimensional Crystal Structures, Three Dimensional Crystal structures, Some Examples of Three Dimensional Crystals, Planes in the Crystals, Crystallographic Directions, Reciprocal Lattice, Quasi Crystals, Bonding in Solids.

UNIT-III

SYNTHESIS OF NANOMATERIALS-I (PHYSICAL METHODS): Mechanical Methods, Methods based on Evaporation, Sputter Deposition, Chemical Vapour Deposition(CVD), Electric Arc Deposition, Ion Beam Techniques (Ion Implantation), Molecular Beam Epitaxy(MBE).

UNIT-IV

SYNTHESIS OF NANOMATERIALS-II (CHEMICAL METHODS) : Colloids and Colloids in solutions, Growth of Nanoparticles, Synthesis of Metal Nanoparticles by Colloidal Route, Synthesis of Semiconductor Nanoparticles by Colloidal Route, Langmuir-Blodgett(L-B) method, Microemulsion, Sol-Gel Methods.

UNIT-V

SYNTHESIS OF NANOMATERIALS-III (BIOLOGICAL METHODS): Synthesis Using Microorganisms, Synthesis Using Plant Extracts, Use of Proteins and Templates like DNA .

UNIT-VI

ANALYSIS TECHNIQUES : Microscopes, Electron Microscopes, Scanning Probe Microscopes (SPM), diffraction Techniques, Spectroscopies, Magnetic Measurements.

UNIT-VII

PROPERTIES OF NANOMATERIALS: Mechanical Properties, Structural Properties, Melting of Nanoparticles, Electrical Conductivity, Optical Properties, Magnetic Properties.

UNIT-VIII

APPLICATIONS : Electronics, Energy, Automobiles, Sports and Toys, Textiles, Cosmetics, Domestic Appliances, Biotechnology and Medical Fields, Space and Defense, Nanotechnology and Environment.

TEXT BOOK:

1. Sulabha.K.Kulkarni., "Nano Technology: Principles and Practices", Capital Publishing Company, New Delhi, 2006.
2. Wilson, M., Smith, G.,Simmons, M. and Raguse, B., "Nano Technology: Basic Science and Emerging Technologies", Overseas Press, New Delhi,2008.

REFERENCES:

1. Ratner,M. and Ratner, D., "Nano Technology : A gentle Introduction to the next big idea", Pearson Education, Dorling Kindersley Publishing, 2003.

OPTIMIZATION TECHNIQUES

(ELECTIVE-IV)

Course Code: ACH1148

L	T	P	C
4	0	0	4

50 Hours of theory + 10 Hours of Lab Practice on MATLAB OPTIMIZATION Toolbox.

AIM & OBJECTIVES:

This course is concerned with formulating the optimization problems and solving them. Advanced topics on Evolutionary Optimization are also treated. MATLAB optimization Toolbox is used to solve large scale optimization problems.

UNIT-I

INTRODUCTION TO PROCESS OPTIMIZATION: Formulation of various process optimization problems and their classification, constrained and unconstrained optimization. Classification of points in the 2D space.

Basic concepts of optimization: Convex Set, Convex functions, necessary and sufficient conditions for stationary points. Calculating Gradient of a function and Hessian matrix. Identifying minima and maxima points.

UNIT-II

LINEAR PROGRAMMING: SIMPLEX algorithm, duality in Linear programming.

UNIT-III

TRANSPORTATION PROBLEM: Solution of Balanced problems using East-West Rule.

UNIT-IV

UNCONSTRAINED OPTIMIZATION: Optimality Criteria, Undirectional search, Powell's Conjugate direction method, Gradient based method: Cauchy's steepest Descent method; Newton's method.

UNIT-V

CONSTRAINED OPTIMIZATION: Kuhn-Tucker conditions, Transformation methods: Penalty function method, method of multipliers.

UNIT-VI

DISCRETE OPTIMIZATION : Enumeration techniques and Branch and Bound method to solve discrete optimization problem**.**

UNIT-VII

GENETIC ALGORITHMS: Working principles, differences between GAs and traditional methods. Various operations like crossover and mutation**.**

SIMULATED ANNEALING : Metropolis Algorithm. (Qualitative treatment of GA and SA only).

UNIT-VIII

MULTIOBJECTIVE OPTIMIZATION (MOO) : Different methods to solve MOO like Utility function method and bounded function method. Solving 2D MOO problems graphically and identifying the Pareto set.

TEXT BOOK:

1. Kalyanmoy D, "Optimization for Engineering Design", Prentice Hall of India, 2005.
2. Rao S.S, "Engineering Optimization-Theory & Practices", New Age International Publishers, New Delhi, 1996.

REFERENCES:

1. Reklaitis, G.V., Ravindran, A., and Ragdell, "Engineering Optimization-Methods and Application", K.M., John Wiley, New York, 1983.